DOCUMENT RESUME

ED 159 023 SE 024 815

AUTHOR Fortner, Rosanne White
TITLE Experiences Related to Oceanic Knowledge and Attitudes of Tenth Grade Students in Virginia.
PUB DATE Jun 78
NOTE 130p.; Ed.D. Dissertation, Virginia Polytechnic Inst. and State University; Not available in hard copy due to marginal legibility of original document

EDRS PRICE MF-$0.83 Plus Postage. HC Not Available from EDRS.
DESCRIPTORS Doctoral Theses; Earth Science; *Educational Research; Knowledge Level; *Marine Biology; *Oceanology; Science Education; Secondary Education; *Secondary School Science; Student Attitudes; *Surveys
IDENTIFIERS Research Reports; Virginia

ABSTRACT

The Survey of Oceanic Attitudes and Knowledge (SOAK) was developed as a method of measuring knowledge and attitudes of tenth grade students and relating those attributes to the students' marine experiences. Fifteen coastal and fifteen inland schools in Virginia were randomly selected as sources of subjects for the study. Analyses of data from 787 tenth grade respondents revealed a statewide knowledge level of about fifty per cent with regard to the marine topics covered by 63 items across three forms of the knowledge survey. Attitudes toward a variety of marine issues were shown to be moderately positive. The relationship between certain demographic variables and the dependent variables of marine attitudes and knowledge was examined. For knowledge, the results indicated the main effects of race, and residence, and interaction between residence and sex. Attitude scores revealed main effects of race only. On the basis of this study, the author recommended that more marine information be included in existing curricula to foster the development of a marine-literate citizenry. (Author/MA)

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EXPERIENCES RELATED TO OCEANIC KNOWLEDGE AND ATTITUDES OF TENTH GRADE STUDENTS IN VIRGINIA

by

Rosanne White Fortner

Dissertation submitted to the Graduate Faculty of the
Virginia Polytechnic Institute and State University
in partial fullfillment of the requirements for the degree of

DOCTOR OF EDUCATION

in

Supervision

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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DEDICATION

For his wise counsel, his encouragement through trying times, and his strength at the family helm, this dissertation is dedicated to my husband, Richard. To my sons Chris and Craig, who were too young to understand what sacrifices they were making, a dedication accompanies a promise that those sacrifices will be compensated. Finally, this work is dedicated to my dear mother-in-law, Helen Fortner, whose quiet and competent care of our family made this accomplishment possible.

ACKNOWLEDGMENTS

The author wishes to acknowledge the able assistance of the members of her doctoral committee: Dr. Thomas Teates, Chairman, for his firm guidance and his confidence in the author's ability; Dr. E. F. Benfield, for providing the scientist's perspective on the study; Dr. Karl Schwaab, for valuable lessons in objective thinking; Dr. Wes Batten, for his input as a marine educator; and especially Dr. Terry Wildman, for his example and assistance in reporting and interpreting experimental results.

Personnel from the Office of Educational Research and the Test Scoring Service of VPI & SU, especially Dr. Lee Wolfle, Dr. Robert Frary, and William Plymale, also contributed valuable technical advice and assistance during the course of this study. Their contributions are gratefully acknowledged.

Finally, the author expresses her sincere appreciation to the school principals and teachers who cooperated in this study. Only through their interest and support could the project have succeeded.

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CHAPTER I

INTRODUCTION

Planet Ocean. Perhaps the name is more appropriate for our sphere than "Earth," for the global sea encompasses more than two-thirds of the planet's surface. It is the sea which gives the earth its character, sustaining life, moderating climates, separating yet connecting the island masses we call continents. Contrary to our fifth grade geography teachings, "there are not many oceans or seven seas, but only one, that encompasses our planet and runs through our nations, our bodies, and our lives." (Pariser, 1977)

The United States has found in the ocean a source of wealth and culture, a means of transportation and trade, a setting for recreation and reflection. More than half of all Americans live within an hour's drive of the sea, but interest in our maritime heritage has floundered while American thought and enterprise have largely focused on the land for the greater part of two centuries.

Our heritage of natural resources in general has been a paradox characterized by abundance and wealth that have in many cases been squandered. There was always more--more land, more water, more oil--here for the taking. The sea especially was so vast that it served as a cheap source of transportation and food and the ultimate repository for the cast-offs of an industrialized society. However, two events in 1969 provided a distinctly different view of our environment and its natural resources, particularly the ocean. One was man's successful journey to the moon, a

feat which afforded nearly all of earth's inhabitants a sort of "whole earth catalog" which showed in living color that ours was a water planet not nearly so vast as previously imagined, but indisputably finite. The other environmental milestone of that year was the National Environmental Policies Act (P.L. 91-190, 1969) which formally established our country's commitment to restoring and maintaining the quality of our environment. Education toward that end was mandated by the Environmental Education Act (P.L. 91-516) of 1970. Through the effects of various legislative acts, American attention has been focused on learning about, conserving the resources of, and repairing damages to the terrestrial, atmospheric and aquatic components of the environment.

The nation's schools have been in the vanguard of this movement, yet the marine portion of the environment, overwhelming as it is in relation to the other portions, receives scant attention in the formal educational process. Occasionally science teachers include marine units in their biology or earth science classes, but few students are ever led to appreciate the ocean's role in influencing such aspects of human culture as the arts, literature, and political affairs. The educational process as a whole frequently ignores or passes lightly over our maritime heritage and its contribution to the nation's development. This dissertation describes an attempt to obtain baseline data for developing programs that could correct this oversight.

The Survey of Oceanic Attitudes and Knowledge (SOAK) was designed to indicate the level of marine knowledge (factual or

conceptual information about the ocean, SOAK Part III) and the prevalent marine attitudes (feelings, values, and opinions about the ocean, SOAK Part II) of a portion of Virginia's school population. Since a successful marine education[1] program also takes into consideration productive presentation techniques, Part I of the survey instrument attempted to identify students' marine related experiences. Experience categories such as watching television or movies, taking regular school classes or ocean study classes, reading for pleasure, and participation in activities at the coast were considered. Respondents indicated which experiences they felt were most influential in establishing their marine knowledge and attitudes. The implications for marine education are clear: if a given experience or set of experiences were rated as influential by respondents who expressed positive marine attitudes, or had high scores on marine knowledge, or both, those experiences which are manipulable could be recommended as possible means of increasing marine awareness. Similarly, if some experiences were consistently correlated with low knowledge scores or negative attitudes, there may be a need for concentrating instruction to overcome the effects of those experiences. Many of the decisions about implementing marine education would thus be removed from the realm of intuition and guesswork. If it were found, for instance,

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[1]Marine education: that part of the educational process, formal and informal, which imparts information about the relationship of the global sea to all world systems and the impact of society upon that sea.

that Jacques Cousteau[2] and Peter Benchley[3] were providing the major portion of our students' marine education, the curriculum could be adjusted to make the greatest use of the contributions and techniques of these and similarly influential persons, events, and activities.

Marine education, in its scientific, historical, artistic, political, and other aspects, has the potential to enlighten and enliven standard curricula and assist in the development of an informed citizenry. In the words of Dr. Harold L. Goodwin (1977), one of the major spokesmen for marine education,

> ...Americans as a whole have little knowledge or understanding of the importance of the world of water, either to themselves or to the nation. A fundamental tenet of a democratic society is that government exists, and decisions are made, with the consent of the governed. Without an understanding of such a primary aspect of life as the importance of both fresh and salt water, people are ill-equipped to participate in vital decisions that affect their own welfare. (p. 18)

For participation in decision-making, for environmental stewardship, even for enhancement of the quality of our leisure activities, a high level of marine awareness is a desired attribute. The data

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[2]Captain Jacques-Yves Cousteau, French inventor of the compressed-air aqualung, the diving saucer, and Conshelf, a sea-floor environment housing oceanauts for on-site study of the ocean. Consteau's books, movies, and television programs have done much to provide the general public with information about the marine environment.

[3]Peter Benchley, author of best-sellers Jaws (1974) and The Deep (1976).

from the present study can be used as a basis for making recommendations concerning effective ways to increase that marine awareness.

CHAPTER II

REVIEW OF RELATED LITERATURE

Scope of Marine Education

Marine education is a part of a larger movement which has been afloat for several decades under the various banners of conservation education, outdoor education, and most recently environmental education. Interest in the sea, however, seems to have gathered a more recent and fervent energy than that which can be attributed to environmental concern in general. During the decade of the seventies we have witnessed not only an awakening to our dependence upon the world of water, but also a revival of interest in our nation's maritime heritage.

Oceanography as a marine science predates modern marine education by a full century, its formal beginnings marked by the voyages of H.M.S. Challenger between 1872 and 1876. In a few schools, marine studies have existed for many years as an occasional science specialty. Two researchers have provided an overview of the nature and extent of marine science in the schools. Schweitzer's (1973a) survey of 400 marine science educators yielded information about programs in thirty states involving approximately 20,000 students in grades 7-12. Schweitzer prepared a Directory of Marine Science Education (1973b) based on his findings. This work was followed by Schlenker's (1976) review of literature related to marine science education, in which he summarized sixty-seven articles carried in the major abstracting

services from 1973 to 1976. Both Schlenker and Schweitzer reported the existence of numerous ocean studies programs in varied forms at all grade levels. Most programs were designed for infusion into existing science programs as interest blocks or extensions of text materials (McFadden, 1973; Naquin, 1975; Anson, 1973). There are notable exceptions, however. Summer enrichment programs (e.g. Eyster, 1975; Cynar, 1977) of several weeks' duration, short courses during the academic year (Faraday, 1975), and programs aimed toward special groups such as dropouts (Boyd, 1973) and those with learning difficulties (Watling and Hallard, 1974) have been developed. A few schools have reported programs of a full school year's duration (Silverstein and Siegel, 1975; Donaldson, 1974).

Present marine education in Hawaii is typical of the diversity of instruction described in Schlenker's review. About fifty per cent of the classes are for advanced students, the other fifty per cent for students who opt out of other science classes, often with weak science or math backgrounds (Klemm, 1977). The material being taught in Hawaiian schools varies with the background of the teacher, so in spite of the existence of a state curriculum guide for marine science there is little consistency in the programs offered. As a possible remedy for the ills associated with a piecemeal approach, the Hawaii Marine Science Studies Project (Hawaii Marine Science Studies, 1977) is now field testing a one-year marine science course for Hawaii's high schools. Study units are organized around the themes of the fluid

earth, the living ocean, technology, and sociocultural studies. The results of project implementation should be of interest to all marine educators.

In coastal regions, all the programs described in the literature included some classroom instruction and made use of field trips lasting from several hours to several days, some on shore and some at sea. Some school systems in California (Los Angeles County, 1977) maintain floating laboratories for marine studies in their schools. Inland schools are not excluded from marine studies because of their geography, however. Charlier and Charlier (1971) have made a strong case for oceanography at the inland school, citing first the appropriateness of treating the subject as another laboratory course and second the need for consideration of ocean law, history, pollution, climate moderation, and other aspects of marine studies that make the ocean important to all regardless of proximity to the coast. Other authors have provided techniques for teaching oceanography without an ocean—Moutvic's (1973) "pickle jar oceanography" and Baird's (1974) "oceanography in a swimming pool," for example. Traveling exhibits such as the Sea Lab mobile unit from the Mathematics and Science Center in Glen Allen, Virginia (Mathematics and Science Center, 1977), and the "tide pools" taken to schools by the New England Aquarium (New England Aquarium, 1977) provide inland students with experiences simulating ocean conditions.

Marine education at the present time is not limited to marine science. Recognition of the impact of the ocean on global

culture and politics has resulted in the inclusion of marine materials in many aspects of the curriculum. Charlier and Charlier (1970) were among the earliest writers to espouse "oceanology as a liberal arts subject." Heitzmann (1975) has suggested methods by which our maritime heritage can secure in social studies education a position that is appropriate to the subject's importance. The Journal of English Teaching Techniques has presented materials with which to plan a multimedia study based on man's interest in and fascination with the sea (Kaufman, 1973). Art teachers may include in their programs the mariners' arts of scrimshaw (Linsley, 1976) and macrame (Berthier, 1977), and the choir director may teach certain rhythms and lyric forms through the use of sea chanteys (National Geographic Society, 1973).

All of these multidisciplinary aspects of marine education, as well as considerations of offshore oil, coastal zone management, fisheries regulation, law of the sea, and so on, are included in comprehensive oceanic studies such as the program at McLean High School in McLean, Virginia (Donaldson, 1974, 1977). In its four years of operation, participants have been taught by instructors from all departments of the school. They have heard artisans and ambassadors from many countries, and speakers from the military, municipal, and commercial groups using the Chesapeake Bay. Field trips have focused at times on maritime culture, history, marine sciences, or ocean recreation. Viewed in relation to other programs described in the literature, the McLean program represents the modern view of formal marine education in its most comprehensive form.

Marine education, of course, may be acquired without the aid of a school. Organizations such as the Sea Explorers (Richardson, 1977) and private corporations such as Sea Camps, Inc. (Sea Camps , 1977) offer young people the opportunity to participate in marine-related activities that are not purely recreational in nature. The New Jersey Marine Education Association (Summer Sailing Weekend, 1977), Schooner, Inc. (Schooner, 1977) and others have responded to the revived interest in the Age of Sail by equipping vessels and training laymen in their operation. Old Mystic Seaport in Connecticut, Ships of the Sea Museum in Georgia, and the Mariners Museum in Virginia are among public institutions preserving and illuminating our maritime heritage (Laing, 1974), while Sea World, Marineland, and public aquaria in many major cities cater to our fascination with the living things of the sea. Finally, the exposure of millions of people to the wonders, dangers, and problems of the sea has been accomplished through television specials, news media coverage of marine topics, and popular fiction and films. The informational and attitude-influencing value of these last sources has not been documented for marine education but will be considered for their possible effects in a later section.

Marine Awareness Studies

> As we have been told on numerous occasions, we know more about the backside of the moon than we do about the drop of water upon which each of us, and all living organisms, depend for survival (Slonim, 1977, p. 5).

In spite of the number and variety of marine education experiences available, our collective ignorance about the world

ocean is acknowledged in frequent writings (Slonim, 1977; Goodwin, 1977; Heitzmann, 1975). It is difficult, however, to find empirical data to substantiate such claims. Only three reports of marine awareness assessments were found, and two of these are currently incomplete and unpublished. In the single published reference, Needham (1975) designed and tested an instrument for measuring attitude changes toward the sea among ninth grade Samoan students. His results indicated that those students who had participated in the Samoan Sea Study Laboratory had significantly (α=.01) "improved" attitudes in comparison with nonparticipants. Needham has reported that conceptual knowledge and attitudes toward the sea are "strongly related," although scores of the same students on a general knowledge test were correlated more closely with region of residence than with program participation.

While Needham's study was concerned mainly with marine attitudes, marine knowledge is the focus of work being done by Marcia Leek (1977) at the University of Delaware. Leek's Marine Environment Awareness Tests for grades 4, 8 and 11 were designed to assess the impact of some of the Project COAST materials (Geens and Stegner, 1974). Coastal/Oceanic Awareness Studies (COAST) is a multidisciplinary resource collection of learning experiences from which lessons may be selected for infusion into existing courses of study in grades K-12. Four states, Delaware, Maryland, New Jersey and Virginia, participated in Ms. Leek's original testing program, and schools in other states have now been invited to join in the study. Preliminary results in the four states using

thirty-question surveys show mean scores of 42.66 per cent correct responses in grade 4, 34.2 per cent in grade 8, and 38.89 per cent in grade 11. These results have been interpreted by the Project COAST staff as an indication of the need for marine education, but until there is a formal report on how the tests were developed and what conclusions are drawn from them, an assessment of their implications is not practical.

An instrument developed by Howe and Price (1976) combines attitude questions and factual items into three forms of a forty-item test. The survey has been field tested in thirteen midwestern and northeastern states, but results are not in publishable form at this time. Preliminary testing of 1723 tenth and twelfth grade students in Ohio, however, indicates that the subjects "did not have a high level of understanding of the information assessed." The authors apparently did not analyze for total knowledge and total attitude scores separately, because only individual item scores are presented in the preliminary report (Howe and Price, 1976). The instrument includes items from marine literature, history, and geography as well as science. Item scores may indicate which topics are receiving little attention in the formal educational process, but lack of published total scores and separate attitude summation limits the usefulness of the study for purposes of generalizing about the state of the art in marine education.

Assessment procedures used in marine programs are related to the purposes of those programs. Evaluation of academic courses is used to assess knowledge acquisition (Giles, 1978). Enrichment

programs are as much concerned with affective as with cognitive changes in participants, so their evaluation consists of attitude measurement and ratings of the experiences, with factual testing de-emphasized or deleted (Rosenberg, 1977). Recreational activities, the mass communications media, public aquaria, and other similar activities provide informal marine education which often goes unidentified as to source and unevaluated with regard to impact on the learner. In general, then, one could expect to deal with many kinds of evaluation procedures in obtaining data about marine awareness.

Environmental Knowledge and Attitudes

Literature in the social sciences abounds with research attempting to relate knowledge about a topic to attitudes toward that topic. Only those studies dealing with environmental topics will be reported here, since work in marine education is in large part a form of environmental education.

The present study proposes to investigate the relationships between existing attitudes toward the ocean and knowledge of the marine environment. Pettus (1974) reviewed literature (Hendee, 1972; Smith, 1973; Tichenor, et al., 1971) which seemed to him to indicate that "the differences in the amount of scientific and other facts received by persons... have little effect on their attitudes toward the environment." Pettus maintained that environmental programs in schools could still be justified if such programs devoted more time and energy to value and attitude development and less to the teaching of specific facts associated with environmental quality.

On the other hand, a number of studies with considerable geographic scope support the existence of a direct relationship between environmental knowledge and attitudes. In the United States, Perkes (1973) examined the environmental knowledge and attitudes of tenth and twelfth grade students in 199 schools of six far western and five Great Lakes states, and Bohl (1976) repeated the study for students in 270 schools in six mideastern, four southwestern, and twelve plains and mountain states. Both authors reported similar outcomes. For the most part, students scored better on conceptual knowledge items than on factual knowledge in environmental matters, and attitudes tended to be favorable toward the environment.

Perkes (1976) later analyzed his data further by randomly selecting 100 of the students scoring in the top ten per cent and 100 of those in the lowest ten per cent for a comparison of their environmental attitudes. His results showed that

> (a) There are significant differences in some attitude responses of high knowledge and low knowledge scorers. In general, high scorers tended to have more positive environmental attitudes than low scorers.
>
> (b) High knowledge scorers were less variable in their responses than low knowledge scorers.
>
> (c) General environmental attitudes which do not indicate an eventual behavioral change tend to be viewed more positively than those items which require personal commitment and behavioral adjustment.
>
> (d) Low knowledge scorers were less interested in participation in environmental decision-making than high knowledge scorers. (p. 1).

The results of studies by Eyers (1975) in Australia and Richmond (1976) in England were in most respects similar to those reported above, with Richmond making the distinction that conceptual knowledge correlates more strongly with attitudes than does factual knowledge.

Other research has approached on a smaller geographic scale the question of whether environmental knowledge is related to environmental attitudes. In general, most of these studies had similar results. Hollingsworth and Cohen (1972) tested high achievers' attitudes in comparison with those of low achievers in seven Indiana high schools, and found that those who knew more content had "markedly different" attitudes (stronger and more positive) from those who knew little. George (1966) noted a significant attitude change after his sample of high school, college, and adult subjects received instruction in conservation education. In North Carolina, Hounshell and Liggett (1973) found a relatively strong correlation ($r=0.6$) between subjects' scores on the knowledge and attitude subtests of their Environmental Knowledge and Opinion Survey (EKOS). This led the authors to postulate that

> ...one viable approach to creating constructive environmental attitudes appears to be through providing knowledge about man's environment and his role in the environment to the student. This would lead one to believe that a well-structured, well-planned approach to environmental education will yield positive attitudinal changes. (p. 30).

The substitution of "marine" for "environmental" in the last sentence of the Hounshell and Liggett quotation produces something of a policy statement for the marine educator. Indeed, the movement toward extending marine education parallels early environ-

mental education thrusts in its emphasis on providing knowledge of the subject as a basis for establishing favorable attitudes toward it.

Factors Related to Environmental Knowledge and Attitudes

The present study has attempted to identify relationships existing between knowledge, attitudes, proximity to the ocean, and the marine-related experiences students have had. Many of the authors who have assessed environmental knowledge level and attitudes also have attempted to correlate one or both sets of attributes with some independent variables among the population. For the most part these variables have consisted of sex, age, residence, achievement, or socioeconomic status. Moyer (1975), for example, has investigated environmental knowledge and attitudes of high school seniors in relation to several school factors. His results failed to reveal significant correlation between attitudes and grade point average or socioeconomic status. Some significant but low correlation was noted between the affective test and science grades, while cognitive test scores correlated highly with grades in science and social studies. Moyer concluded that "wherever these students have formed their attitudes toward the environment, as measured by the SEAT (Kleinke and Gardner, 1974), they are not being influenced to any great extent in the classroom." On the other hand, if the studies relating knowledge level to attitudes are reliable, perhaps Moyer's study should be expanded to include possible correlation of attitudes with other knowledge indicators

besides science grades and GPA. Miller's (1972) research on pre-adult attitudes toward environmental concerns indicated that attitudes begin to form in the primary grades and become almost fully developed in high school, but nowhere did he indicate that school factors were responsible for this development.

In a study of attitudinal patterns associated with conservation, Hoover and Schutz (1963) found that conservation attitudes were influenced by a number of factors, including a person's cultural beliefs and his concept of such things as individual liberties and democratic principles. Later studies (Hoover and Schutz, 1964) comparing the conservation attitudes of science and non-science majors indicated that the difference between the groups was significant "but so slight as to be of no practical significance."

Age factors are often considered in attitude studies as well, though at times the effects of increased knowledge and maturation confound age considerations. Perkes (1973) and Bohl (1976) reported that twelfth graders scored higher than tenth graders on environmental knowledge, but environmental attitudes were unrelated to grade level. Similarly, George (1966) found that among high school students, college students, and adults (not necessarily college graduates), the adults held conservation attitudes that were significantly different from those of the other groups. In the National Environment Test (Lynch and Chandler, 1970) the CBS news poll took a nationwide sample of 450 subjects aged sixteen or older. Highest scores were made by those in the group aged 30 to 44. Pettus' (1974) study showed that the age

of teachers was significantly related to specific environmental attitudes. His Scale II, labeled "The need to prepare for the future" elicited higher scores from younger teachers while older teachers had more favorable attitudes on Scale III, "The need for policies and controls to prevent environmental pollution and degradation." Pettus interpreted these scores as indications that older people are more practical about what can be done for the environment and feel less of a need to ensure a quality environment for the future.

Sex as a factor influencing environmental knowledge and attitudes has been investigated as part of most of the works previously reviewed. The teachers in Pettus' (1974) study differed in their attitudes toward those environmental issues having to do with "The need for policies and controls to prevent environmental pollution and degradation." Male teachers approved more of present policies and controls while female teachers favored more numerous and rigid controls for preserving the environment. In many of the studies (such as Lynch and Chandler, 1971) males showed significantly greater environmental knowledge, but the studies dealing with attitudes as well (Perkes, 1973; Bohl, 1976; Richmond, 1976) revealed no relationship between sex and environmental attitudes. In this respect one additional study differs markedly. Hounshell and Liggett's (1973) survey of sixth graders in North Carolina noted no significant differences in knowledge scores based on sex, but females scored higher on environmental attitudes at the .001 level of significance. The limited scope of the North

Carolina study in comparison to the other investigations and the maturation level of sixth graders in general are presumed to account for these differences.

Community size and geographic location have been shown to be related significantly to both environmental knowledge and attitudes in the studies of Perkes (1973), Bohl (1976), Richmond (1976), Eyers (1975), and Hounshell and Liggett (1973). Both of these demographic factors are apparently important determinants of responses to perceptual questions such as identification of the most serious pollution problems and how much can be done about such problems. Erskine's (1972) summary of environmental items in national polls indicated that in the United States easterners were most concerned about air and water pollution, and southerners were least concerned. In the midwest, unclean water was the primary issue, while air pollution was considered the worst problem in the far west. Suburban dwellers were more aroused over environmental degradation than were residents of big cities.

In this study some of the same demographic variables were considered in relation to marine knowledge and attitudes. Additional population characteristics in the form of marine related experiences were considered in order to extend the list of possible predictor variables for marine education purposes. Of particular interest were those experiences which could be cited by individuals as knowledge sources and therefore might serve as possible attitude sources. Two authors (Perkes, 1973; Bohl, 1976) have approached this problem by including in their surveys a perceptual item asking

students to identify the source of most of their knowledge about the environment. About 60 per cent of the subjects in both studies selected sources outside the school (media, discussions, self-education) as the most important knowledge source. Fewer than 40 per cent chose school-related sources, and of those subjects less than seven per cent listed "special environmental courses" as a primary influence. Neither study indicated what proportion of the subjects had actually taken such a special course. Both authors concluded that media sources do have an important role in the acquisition of environmental knowledge. These findings may have a direct application for marine education: if in fact a "special course" in marine studies were not important as a knowledge source, the transmission of marine information might best be accomplished by other means. This study will expand the technique used in the foregoing works, in hopes that experiences influencing marine knowledge and attitudes may be identified and used.

Summary

Marine education programs in the educational system exist in various forms according to local environments, student age and preparation, existing curricula, and teacher initiative. While most programs are based in the sciences, there is a trend toward a multidisciplinary approach combining the arts, social studies, and sciences into an integrated picture of the ocean's influence on human existence.

While it is suspected that Americans in general know little about the ocean and its effects on mankind, empirical data to that effect are not readily available. The few studies attempted through the schools were incomplete at the time of this writing. The effect of informal marine education, through recreation, the mass communications media, and public institutions such as Sea World, frequently goes unevaluated.

Oceanic knowledge, in whatever quantity and acquired by whatever means, may be related to the oceanic attitudes of individuals. Research in other areas of environmental concern indicates that such relationships are not uncommon, but neither are they indisputable. Oceanic attitudes may result from combinations of demographic variables, for there are a large number of factors that influence environmental attitudes in general. Identification of oceanic knowledge sources may provide clues to the origin of oceanic attitudes.

CHAPTER III

METHODOLOGY

Overview

This study consisted of the development of an instrument, collection of data and analyses of the data obtained to answer the question: For Virginia's tenth grade students, what marine-oriented experiences are related to knowledge level and attitude set regarding some marine topics? Because proximity to the ocean was considered to be a likely influence on the attributes measured, stratified sampling techniques were used to make possible the separation of survey responses from coastal and inland high schools. The responses obtained from the two geographic areas were analyzed separately to facilitate identification of similarities and differences between the two subsamples on the attributes measured.

Subjects

The sample consisted of 825 tenth graders selected from coastal and inland high schools in Virginia. The tenth grade level was selected for the study for several reasons. First, a review of the literature suggests that there is a direct positive relationship between knowledge level and positive attitudes toward the environment (Bohl, 1976; Eyers, 1975; Hounshell and Liggett, 1973; Perkes, 1976; Richmond, 1976). The course work most likely to provide information about marine topics is a series of courses (geography, earth science, and biology) that in most

Virginia school systems is completed by the end of the tenth grade. While none of these courses is specifically required for high school graduation in the state, many students elect to complete required credits in science and social studies as early as possible in their secondary school careers. The availability of the listed courses in grades eight through ten frequently results in their being chosen to meet credit requirements. If these courses should be a major source of marine knowledge and therefore an influence on marine attitudes, surveying the sample near the end of the tenth grade was considered to provide optimum opportunity for recency of exposure and maximum retention of marine information.

In addition, Miller (1972) has reported that "the pattern of eighth grade attitudes toward environmental issues is not significantly different than those of the adult population." Therefore, assessment of attitudes among students in the eighth grade or beyond could provide insight into the attitudes of adults. Finally, Virginia students are required by law to remain in school until they reach the age of seventeen. Most tenth grade students are fifteen or sixteen years old, so sampling at this level should include some of those students who are potential dropouts. This would help to prevent a bias toward the more academically oriented students who might remain in higher grades.

The target population was sampled in the following manner: the Code of Virginia (1950), Section 62.1-13.2, defines "Tidewater Virginia" as including those municipalities to the right of the line shown on Figure 1. Based on this division of the Commonwealth,

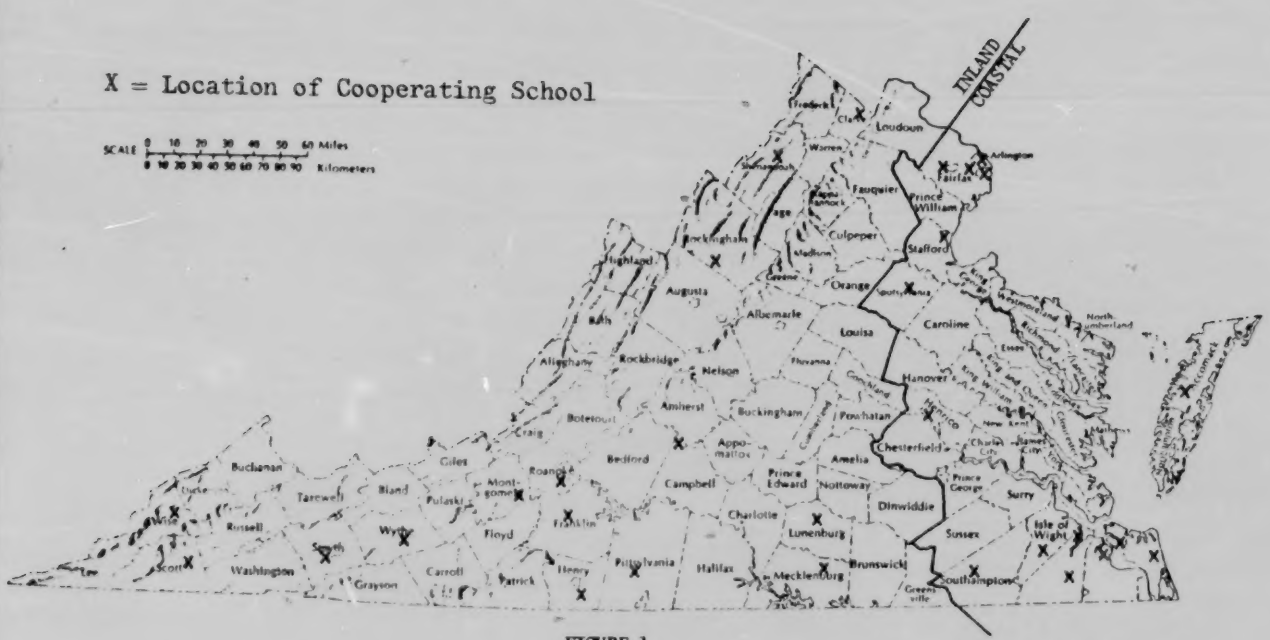


FIGURE 1

DISTRIBUTION OF COOPERATING SCHOOLS IN
COASTAL AND INLAND AREAS OF VIRGINIA

two lists of secondary schools (coastal and inland) were developed, and fifteen schools from each list were randomly chosen to participate in the study. Four schools originally invited elected not to participate and were subsequently replaced by alternate schools chosen in the same manner from the same geographic area. The schools thus selected included twenty-six public secondary schools, one school for military dependents, one coeducational private school, one predominately male and one predominately female private boarding school. Within each school a cooperating teacher identified by the principal was instructed to select a class of about thirty tenth graders representing as nearly as possible the entire range of ability levels in that grade. These students served as the sample for the study. Appendix A contains a list of participating schools, and Figure 1 indicates their distribution across the state.

Instrument Development

The Survey of Oceanic Attitudes and Knowledge (SOAK) is a three-part instrument designed to identify the marine-related experiences students have had and the marine attitudes they express, and to determine the students' level of marine knowledge. The Marine Experience Profile, Part I of the survey, was constructed by the author using items from her own experience and from two other sources. First, an oceanography class in Roanoke County, Virginia, was asked to produce a list of all the factors the members felt had influenced their knowledge or attitudes about the ocean. This

list was then broadened by inclusion of other possible experiences as described in workshops and general sessions at the 1977 convention of the National Marine Education Association. Of the sixty items on the experience profile, twenty-eight required a yes/no response indicating whether the student had the experience. Remaining questions probed the degree to which the student had participated in certain activities. Finally, the experiences were grouped into ten categories and students were asked to arrange these in order of their importance in helping them to learn about the ocean.

The remainder of the Survey of Oceanic Attitudes and Knowledge (SOAK) was divided into two sections for the separate assessment of attitudes and knowledge. The attitude section consisted of fifteen statements about the importance of the ocean and man's use of the ocean, to which students responded on a five-step Likert scale (strongly agree to strongly disagree).

The knowledge section (Part III) of the SOAK was assembled from a pool of over two hundred items, including many constructed by the author and others identified from the literature (Hounshell and Liggett, 1973; Howe and Price, 1976; Leek, 1977; Richmond, 1976). Items were categorized as to whether their content dealt with the ocean as (1) a chemical medium, (2) a physical system, (3) a biological community, (4) a political interface, (5) a cultural influence, or (6) a threatened resource.

In order to limit the length of the entire instrument and facilitate administration during a single class period of at least forty-five minutes, multiple forms of the knowledge section were

developed. Forms A, B, and C each contained twenty-five questions divided among the six item categories as shown in Appendix B. Six of the items were common to all three forms as a method of comparing response patterns of subjects taking different forms of the test. The use of complementary forms permitted data collection on a larger number of items than would have been possible on a single test.

Since it was expected that some items would be shown in the review process or the pilot study to be invalid or nondiscriminatory, Form D was developed using twenty-five "spare" questions that could be used as replacements. The complete SOAK instrument package was presented to twelve reviewers for critique of content, relevance, item construction, and appropriateness for the population. Each reviewer was also asked to indicate which responses to attitude items they would consider "positive." Positive attitude responses were defined as decisions based upon knowledge of ecological principles, political and economic feasibility, environmental stewardship, or any combination of these factors. A list of reviewers appears in Appendix C.

Pilot Studies

The Survey of Oceanic Attitudes and Knowledge was field tested in November, 1977, using a heterogeneous class of tenth grade students in each of two Roanoke County, Virginia, high schools. On the basis of the results of this test, several items were deleted from Forms A, B, and C and replaced with more

discriminatory items from Form D. Other items indicated by student comments to be confusing or misleading were rewritten.

The revised instrument was re-examined by eight of the reviewers and tested again in December, 1977, with four classes of inland students and one class of coastal tenth graders. Students were asked to write comments about items directly on the survey forms, and several students from each class were interviewed by the author or cooperating teacher following the survey administration to obtain further comments on the instrument.

Final Instrument Form

Following the pilot studies the SOAK was prepared in its final form. Only minor revisions were necessary in the Marine Experience Profile (Part I), these largely taking the form of grouping items into categories of experience and altering some choices in the "degree of participation" items.

Part II, dealing with attitudes, underwent major revision. First, because the "neutral" choice of answers created the opportunity for students to respond without considering all options, the neutral choice was eliminated and a four-point scale (definitely agree, tend to agree, tend to disagree, definitely disagree) substituted for the original five-point system. Next, three items were deleted as being too strongly based on factual knowledge. Finally, remaining items were rewritten to avoid ambiguity, leading

phrases, and multiple concepts. Of the fifteen attitude items on the final survey form, twelve were constructed by the author. The sources of other items are given in Appendix B.

The knowledge section of the SOAK, Part II, was reduced to three forms and additional items written to fill the item matrix gaps produced by deleted questions. Some items were moved from one form to another in an attempt to make the three forms fairly equivalent in level of difficulty. Comparison of forms was made on the basis of mean knowledge scores and standard deviations on each form in the second field test. Appendix B shows the sources of knowledge items and their distribution by category on all forms of the instrument. The Survey of Oceanic Attitudes and Knowledge appears in its final form as Appendix D.

Instrument Validity and Reliability

The process of review by oceanographers, marine educators, and high school teachers was intended to evaluate and enhance the content validity of the instrument. In addition, the appropriateness of the language and content of the survey was assessed directly through field test appraisal by students.

An item analysis was performed to examine the relationship between scores on the twenty-five question knowledge section and the number of persons choosing the correct answer to each item. For the most part, only those items having a correlation coefficient greater than or equal to .30 were included in the final instrument. In a small number of cases (Items 70, 86A, 87B, 75C), content of an

item was considered by the author to be so vital to marine awareness that the item was included in spite of a low correlation coefficient in the pilot study analysis. A measure of the internal consistency of the knowledge portions of the survey was given by a Kuder-Richardson formula 20 reliability statistic (Ferguson, 1976), and reliability of the total instrument package was determined by retesting the students who had taken the revised form of the survey. Retesting was done one week after the survey was first administered.

Data Collecting Procedure

In December of 1977, principals of the high schools chosen for the sample were contacted by mail and invited to participate in the study. A self-addressed post card was enclosed for the reply. Principals agreeing to participate were asked to name from within their schools a cooperating teacher to whom materials could be sent. The purpose of the study was then explained in a letter to each cooperating teacher. A description was given of the type of class to be chosen, and a reply post card was provided to indicate how many survey forms would be needed for the class. Copies of the introductory letters and reply cards are found in Appendix E.

In mid-January of 1978, survey materials were mailed to participating schools. In addition to copies of the survey and answer sheets, materials included a list of specific instructions for administering the survey and a "General Information" form requesting demographic characteristics of the school population

(Appendix F). Pencils bearing the SOAK-78 logo were enclosed for students to keep after using them to complete the survey, and stamped envelopes were provided for the return of the completed answer sheets.

Teachers were asked to administer the survey during a single class period no later than February 10, 1978. School closings caused by winter storms delayed the receipt of many answer sheets, but schools not responding by February 20 were contacted as a reminder that their forms had not been received. By March 15, all thirty schools had returned answer sheets.

Analyses of Data

The independent variables in this study were the ten categories of marine-related experiences, such as movies with marine themes, recreation at the beach, and ocean study classes. The relative value of these variables was determined by the respondents' ranking of them on the Marine Experience Profile (Part I of the SOAK). Sex, race, and the two residence classifications, coastal and inland, also functioned as independent variables. Dependent variables were the students' scores (number correct) on the knowledge section (Part III) of the survey and their mean attitude scores from Part II.

In preparation for data analyses, answer sheet data were reviewed upon receipt. An identifying school number was coded onto each sheet, and positioning of other identification data was checked and corrected if necessary. Answer sheets on which no test form was indicated and those bearing obvious diagonal designs in

the ten-choice section were deleted from the survey results as being invalid. The remaining data were then transferred onto computer cards for later analyses using subprograms of the Statistical Package for the Social Sciences (Nie, et al., 1975). Characteristics of the sample schools, as provided on the General Information form returned by cooperating teachers, were compiled into Table 1.

Initial analyses of the three parts of the survey were designed to determine knowledge scores, attitude scores, and ranks for each of ten categories of marine-related experiences. Knowledge scores were computed by counting the total number of correct answers to Items 66 through 90. Twenty-five was the possible score. Because the knowledge section was administered in three forms, a check for form equivalence was made by means of one-way analyses of variance of the mean knowledge scores on all forms and on subscores computed using the responses to the six items (Item 66 through 71) which were common to all forms. The distribution of frequencies for each response to the six common items on all forms of the SOAK was examined by a chi-square analysis.

Attitude scores were produced by calculating the mean response (ranging from one to four) for attitude items 51 through 65. Responses to Items 52, 55, 59, 60, and 64 were reversed for this computation (1=4, 2=3, 3=2, 4=1), since these items required an "agree" response to indicate a positive marine attitude, whereas all other items in SOAK Part II had disagreement as an indication of a positive attitude.

TABLE 1

SUMMARY OF GENERAL INFORMATION
FROM COOPERATING SCHOOLS

Characteristic	Choices	Number of Schools[a] Coastal	Inland
School enrollment	(a) more than 1500	5	1
	(b) 1000 to 1500	4	3
	(c) 500 to 599	4	7
	(d) less than 500	2	4
Area served	(a) large city	0	0
	(b) suburban area	8	2
	(c) medium-sized city	2	1
	(d) town	0	2
	(e) rural area	5	10
Population served	(a) upper class	1	0
	(b) upper middle class	3	2
	(c) middle class	6	7
	(d) lower middle class	4	6
	(e) lower class	0	0
Survey given in	(a) science class	11	10
	(b) social studies class	1	0
	(c) language arts class	3	4
	(d) mathematics class	0	0
	(e) other (entire tenth grade)	0	1
Ocean study course	(a) in at least one feeder school	0	1
	(b) in the school, in or before Grade 10	1	0
	(c) in the school, Grade 11 or 12	1	0
	(d) not at all in the school	13	15[b]

[a] Total N = 15 Coastal and 15 Inland

[b] Column total = 16 for inland ocean study courses because one school indicated both choices a and d.

For each of the experience categories ranked in Items 101 through 110, a mean rank was obtained, and based on these ranks a "Scale of Perceived Influence" was constructed for each geographic subsample, showing the order of importance of each type of experience as perceived by the group. Stepwise multiple regression was used to determine the degree of linear dependence of knowledge and attitudes upon the ranked experiences. Within the ranked categories, those specific experiences which were of particular interest because of a substantial relationship to knowledge or attitude scores were examined further. Arbitrarily it was decided that variables accounting for at least ten per cent of the variance in knowledge or attitude scores were important enough for separate stepwise regression analyses. Since these items were the ones that had been combined into the categories of experience in Items 101 to 110, the second set of regression equations was simply a more specific identification of experiences related to marine knowledge or attitudes.

Demographic variables in addition to residence also were considered as having possible relationships to marine knowledge and attitudes. Accordingly, the main and interactive effects of race, sex, and residence classifications on knowledge and attitude scores were examined by analysis of variance.

Finally, an overview of the types of responses to attitude statements and item categories within the knowledge section provided indications of specific attitudes toward marine issues and identified areas of strength and weakness in marine-related subject matter. Such information may prove to be of value in the implementation of marine education programs.

Summary

The Survey of Oceanic Attitudes and Knowledge was developed as a method of measuring marine knowledge and attitudes of tenth grade students and relating those attributes to the students' marine experiences. Pilot studies provided information on the validity of the survey items, the suitability of vocabulary and format, equivalence of forms, and test-retest reliability. Content validity was evaluated by a panel of reviewers in fields related to the study.

Fifteen coastal and fifteen inland schools in Virginia were randomly selected as sources of subjects for the study. Principals identified a cooperating teacher in each school to administer the survey to a heterogeneous class of tenth grade students. All of the sample schools returned usable data.

Preliminary analyses of survey responses determined the practical equivalence of the three survey forms. Knowledge scores were subsequently totaled, attitude means were generated, and the relationship between the two attributes was examined. To fulfill the major purpose of the study, the marine experiences of the students were considered both specifically and as experience

categories in relation to marine attitudes and knowledge. Demographic variables of race, sex, and place of residence also were examined in relation to the dependent variables. Finally, the substantive nature of student responses was analyzed to provide baseline information on areas of strength and weakness in overall marine awareness of the group.

CHAPTER IV

RESULTS

A total of 825 tenth grade students was surveyed in the thirty cooperating schools using the Survey of Oceanic Attitudes and Knowledge (SOAK). Data for thirty-eight students (4.5 per cent) were eliminated from analyses because answer sheets were improperly prepared according to previously discussed criteria. Of the 787 students whose data were actually included in the analyses, 366 were from schools classified as "inland" and 421 were from "coastal" schools.

Preliminary Analyses

An attempt was made to generate three equivalent forms of the knowledge section of the SOAK. Descriptive data for each form are reported in Table 2. The results of a one-way analysis of variance revealed that the knowledge score means did differ significantly, $F\ (1,784) = 5.077$, $p < .01$, across forms. Subsequent comparisons of forms (Tukey's multiple range test of group means) produced homogeneous subgroups composed of Form A with Form B and Form A with Form C, thus forming a continuum of survey form means in the order of B-A-C ($\bar{X} = 12.8$, 12.4, and 11.7, respectively). The extremes of the continuum differ at the .05 level, and the difference creates some difficulty with regard to combining all forms for subsequent analyses. To test whether the groups taking different forms of the survey were simply random samples from a single population with regard to marine knowledge, an analysis of variance was

TABLE 2

DESCRIPTIVE STATISTICS BY SURVEY FORM
FOR SOAK PART III: KNOWLEDGE

Statistic	Survey Form A	B	C	All
Number of students	267	261	259	787
Mean number of correct answers	12.43	12.78	11.68	12.40
Standard deviation of number of correct answers	4.225	3.522	3.860	3.910
Reliability estimate (KR-20)	0.708	0.624	0.671	----
Standard error of measurement	2.282	2.159	2.214	----

performed using the means of the six identical items as dependent variables. Results again indicated a significant form effect, $F(1,784) = 3.68$, $p < .05$, however, the proportion of the total variation accounted for by the mean differences was less than one per cent. This indicates that for practical purposes the three groups were equivalent with regard to marine knowledge, and that differences among groups when all items are considered are probably a function of differences in the level of difficulty of items unique to each form.

An additional test of the equivalence of the three groups was performed by using chi-square analyses to test the equivalence of response distribution on the six items common to all forms (Table 3). Results indicated that the response patterns were the same across all forms. Separate analyses were done with the knowledge scores from each of the three test forms. The results indicated that there was no test form effect on any of the major relationships between knowledge and other variables.

Marine Knowledge and Attitudes

One of the major goals of this study was to provide an indication of the level of marine knowledge and type of marine attitudes of Virginia's tenth grade students. Knowledge scores were generated by totalling the number of correct responses. Out of a possible score of 25, the mean knowledge score for the entire sample was 12.40 (about 50 per cent correct). Attitude scores were obtained by averaging the responses to the fifteen items in Part II of the survey. The sample mean of 3.06 out of a possible 4.0 is indicative

TABLE 3

SUMMARY OF CHI-SQUARE TESTS OF INDEPENDENCE
BETWEEN SURVEY FORM AND RESPONSES TO ITEMS 66 - 71

Item Number	Degrees of Freedom	Calculated Chi-Square	Chi-Square at $\alpha = .05$	Significance
66	8	11.12	15.51	0.1951
67	4	8.97	9.49	0.0618
68	6	5.37	12.59	0.4970
69	6	6.14	12.59	0.4077
70	6	9.38	12.59	0.1534
71	6	6.18	12.59	0.4031

of a moderately positive attitude toward the aggregate of marine issues included in this section of the SOAK.

In order to examine the relationship between certain demographic variables and the dependent variables of marine attitudes and knowledge, a race (2) by sex (2) by residence (2) analysis of variance was performed on the knowledge and attitude scores. For knowledge, the results indicated the main effects of race, $\underline{F}$ (1,772) = 68.2, $\underline{p} < .01$, sex, $\underline{F}$ (1,772 = 26.5, $\underline{p} < .01$, and residence, $\underline{F}$ (1,772) = 26.1, $\underline{p} < .01$, and an interaction between residence and sex, $\underline{F}$ (1,772) = 8.7, $\underline{p} < .01$. Substantively, white students scored higher than non-whites. The main effects of sex and residence on knowledge scores are qualified by the interaction shown in Table 4. The interaction suggests that knowledge differences by residence exists only among males, with coastal males having a higher knowledge level. Only for coastal students were there pronounced differences between the knowledge scores of males and females, with males having the higher knowledge level. The analysis of variance for attitude scores according to the same demographic variables revealed main effects of race only, $\underline{F}$ (1,772) = 42.6, $\underline{p} < .01$, with white students expressing more positive attitudes. Knowledge and attitude means upon which these calculations are based are shown in Table 5.

Because related studies have indicated that knowledge about the environment may be related to environmental attitudes, this study examined the relationship between marine knowledge and attitudes. When a Pearson product-moment correlation coefficient was calculated, the results revealed a significant positive relationship, $\underline{r} = .43$,

TABLE 4

MEAN KNOWLEDGE SCORES BY SEX
AND RESIDENCE

Residence	Sex: Male	Sex: Female	
Inland	12.23	11.60	11.87
Coastal	13.98	11.66	12.86
	13.04	11.63	

TABLE 5

MEAN KNOWLEDGE AND ATTITUDE SCORES
BASED ON RESIDENCE, SEX AND RACE

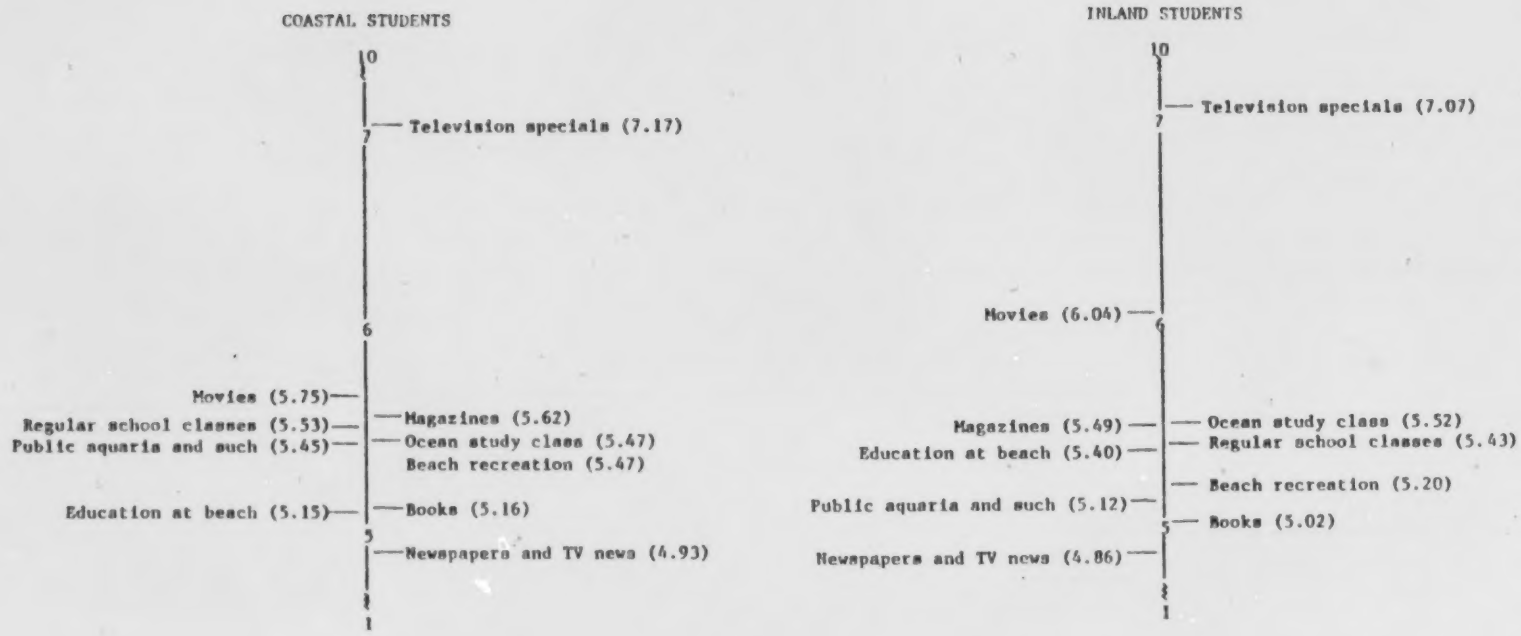
Variable	Mean Knowledge Score/N	Standard Deviation	Mean Attitude Score/N	Standard Deviation
Entire Sample	12.40/775	3.80	3.06/779	0.39
Coastal residence	12.86/416	3.93	3.07/417	0.38
Male	13.98/216	4.01	3.11/217	0.42
White	14.68/170	3.58	3.18/171	0.37
Non-white	11.39/46	4.47	2.85/46	0.49
Female	11.66/200	3.47	3.03/200	0.33
White	12.46/144	3.19	3.09/144	0.32
Non-white	9.61/56	3.34	2.87/56	0.30
Inland residence	11.87/359	3.57	3.05/362	0.39
Male	12.23/154	3.58	3.03/157	0.44
White	12.39/137	3.66	3.04/138	0.45
Non-white	10.94/17	2.56	2.93/19	0.34
Female	11.60/205	3.55	3.06/205	0.35
White	11.74/186	3.47	3.08/185	0.33
Non-white	10.16/19	4.09	2.85/20	0.44

$p < .01$, between the two variables. This relationship was emphasized by a comparison of the attitudes of students scoring in the top fifteen per cent on the knowledge portion of the survey and those scoring in the lowest fifteen per cent. As in Perkes' (1976) study, high scorers tended to have more positive attitudes and be less variable, $\bar{X} = 3.32$, $s^2 = 0.08$, than low scorers, $\bar{X} = 2.79$, $s^2 = 0.18$.

Marine-related Experiences

The major purpose of this investigation was to determine whether any of the marine-related experiences students had were related to their knowledge and attitudes about the marine environment. Each respondent was asked to rank the ten experience categories according to their relative importance in providing information about the ocean. The mean of ranks given to each category was used to generate a "Scale of Perceived Influence" of these experiences on marine knowledge (Figure 2). Coastal and inland students perceived the importance of various experiences in much the same manner. This was consistent with a detailed analysis of the fifty items contained in the first part of the Marine Experience Profile, which showed that students of both geographic areas had participated to the same extent in marine-related activities.

The relationships between marine knowledge and the experience categories as ranked by respondents were examined using a stepwise multiple regression analysis. Data in Table 6 show that only television specials and movies made a noticeable contribution to the amount of explained variation in marine knowledge scores. In fact, even when



Note: Higher numbers indicate greater perceived influence.
Possible range 1-10.

FIGURE 2.

SCALE OF PERCEIVED INFLUENCE OF EXPERIENCES
ON MARINE KNOWLEDGE

TABLE 6

SUMMARY TABLE FOR STEPWISE REGRESSION OF
EXPERIENCE RANKINGS ON MARINE KNOWLEDGE

Experience	Multiple R	R Square	RSQ Change	B	
Television Specials	0.137	0.018	0.018	0.236	
Movies	0.205	0.042	0.023	-0.256	
Newspapers and Television News	0.229	0.052	0.010	-0.213	
Ocean Study Class	0.243	0.059	0.006	-0.119	
Education at the Beach	0.250	0.062	0.003	-0.131	
Magazines	0.253	0.064	0.001	-0.586	D-01
Beach Recreation	0.256	0.065	0.001	-0.688	D-01
Books (outside of School)	0.257	0.066	0.000	-0.163	D-01
Public Marine Institutions	0.257	0.066	0.000	0.993	D-02
(Constant)				14.88	

all ten of the experience categories were entered in the equation, only 6.6 per cent of the variance in the observed knowledge scores was explained.

A similar stepwise regression procedure was used to examine the effects of the ranked experiences on attitude scores. Variables were entered in a different order by the computer program, but again the equation with all ten experiences was able to account for only 5.4 per cent of the variance in observed attitude scores (Table 7).

When correlation coefficients were calculated for the specific experiences in Items 1 through 50 in relation to knowledge and attitudes, thirty were significant at the .05 level for knowledge relationship and thirty-five were significant at the same level in relation to attitudes. Because of the large sample size, the statistical power was such that relationships could be detected that had no practical implications. Correlation coefficients themselves, however, made it possible to identify three items which individually could account for ten per cent of the variation in knowledge scores:

Item 12: Number of Cousteau specials seen on television, $r = -.37$

Item 14: Reading of National Geographic, $r = -.31$

Item 25: Swimming ability, $r = -.34$

(Negative coefficients result from the order in which item choices were listed, low number choices indicating the highest degree of participation.) None of the experience items met the same criterion for relationship to attitude scores.

TABLE 7

SUMMARY TABLE FOR STEPWISE REGRESSION OF EXPERIENCE RANKINGS ON MARINE ATTITUDES

Experience	Multiple R	R Square	RSQ Change	B	
Movies	0.155	0.024	0.024	-0.270	D-01
Television Specials	0.220	0.048	0.024	0.246	D-01
Books (outside of Schools	0.223	0.049	0.001	0.429	D-02
Public Marine Institutions	0.225	0.050	0.001	0.437	D-02
Beach recreation	0.227	0.051	0.001	0.286	D-02
Education at the Beach	0.229	0.052	0.001	-0.579	D-02
Regular School Classes	0.230	0.053	0.000	-0.370	D-02
Newspapers and Television News	0.230	0.053	0.000	-0.357	D-02
Ocean Study Class	0.231	0.053	0.000	-0.189	D-02
Magazines	0.231	0.053	0.000	0.198	D-02
(Constant)				3.04	

Analyses of variance between the knowledge scores of groups choosing each possible response to Items 12, 14 and 25 indicated that the groups were indeed significantly different, and Tukey's multiple range test of group means indicated that greater participation in each of the three activities was related to higher knowledge scores. When the responses to these items were subjected to regression analysis, their cumulative effect accounted for 20.3 per cent of the variance in observed knowledge scores.

Knowledge and Attitude Trend Analysis

As a final type of analysis, descriptive statistics for the knowledge survey were produced to provide an indication of student performance on the six categories of marine knowledge considered. This analysis is summarized by category in Table 8. The data indicate that student performance was relatively consistent across all categories, resulting in nearly equal contributions of the categories to the total knowledge score mean of 49.1 per cent.

As for attitude trends, visual inspection of response means for each attitude item revealed that respondents felt most strongly about potential hazards to the marine environment. Political, economic, and personal considerations were also viewed positively, but attitudes were not as strong on these issues. When attitude scores were divided into four categories from strongly negative to strongly positive, only seven respondents (0.89 per cent) showed a strongly negative attitude and 51 students (6.5 per cent) expressed a slightly negative attitude, while 589 students were slightly

TABLE 8

PROPORTION OF CORRECT RESPONSES (SOAK PART III)
BY KNOWLEDGE CATEGORY

The ocean as a:		Correct Responses Form A	Form B	Form C	All Forms
Chemical medium	N	427	367	472	1266
(3 items per form)	%	53.5	47.2	60.7	53.8
Biological community	N	527	610	673	1810
(5 items per form)	%	39.6	47.1	52.0	46.2
Physical system	N	684	703	458	1845
(5 items per form)	%	51.4	54.3	35.4	47.1
Political interface	N	372	473	422	1267
(3 items per form)	%	46.6	60.9	54.3	53.9
Cultural influence	N	556	701	451	1708
(5 items per form)	%	41.8	54.1	34.8	43.5
Threatened resource	N	592	457	550	1599
(4 items per form)	%	55.7	44.1	53.1	51.0

positive and 140 were strongly positive (74.8 and 17.8 per cent, respectively).

CHAPTER V

DISCUSSION AND CONCLUSIONS

This study provided information about the level of marine knowledge, the marine attitudes, and the marine-related experiences of a sample of Virginia's tenth grade students. From this information inferences may be made regarding the variables that could be related to students' perceptions of the marine environment, and marine educators may find these inferences useful in planning instructional experiences.

It should be noted that a major decision made during the course of the study involved the use of three knowledge survey forms in order to obtain data on student knowledge of a larger number of marine topics within the limited administration time of a 45-minute class period. The value derived from using three survey forms outweighs most of the difficulties involved in managing their analyses. Marine education as an interdisciplinary concern encompasses such a large number and variety of concepts that cursory evaluation procedures assure an incomplete assessment. While the knowledge part of the SOAK is hardly comprehensive as a measure of marine information level, it nevertheless provides a broad coverage of subject matter. To condense the scope of marine education into 25 objective questions would be difficult to justify. A single knowledge test of such a length would allow the entire SOAK to be administered within a single 45-minute class period but would provide less than 40 per cent of the information that is now available from the use of three forms. The alternative of

administering a longer knowledge test during a second class period would have been an unreasonable demand upon the generosity of the cooperating teachers and possibly would have resulted in a lower rate of returns.

Discussion of Results

Student performance on the knowledge section of the SOAK resulted in a statewide average of 12.4 out of a possible 25 (about 50 per cent), with 93 per cent of the subjects expressing positive attitudes toward marine issues. Comparison of the mean attitude measures of those who scored in the top 15 per cent and those in the bottom 15 per cent on marine knowledge indicates that stronger (more positive) and less variable marine attitudes are associated with greater marine knowledge.

An examination of the attitude survey itself may provide some explanation of the overall positive nature of responses. The marine attitudes measured by the SOAK are a composite of feelings, beliefs and opinions. Responses to some items, such as those involving the use of trenches as garbage dumps and the desirability of shark extinction, are probably based on an understanding of the basic concepts of earth forces and biological interrelationships. Other items call for opinions about government or corporate responsibility for the use of ocean resources. While seven of the attitude statements deal with preservation of the marine environment, only one implies that a personal behavior could be involved (fencing off a section of beach for private use). Most environmental issues entail an aspect of per-

sonal behavior as a commitment to their cause, whereas there are probably few individuals who act on the assumption that their personal behavior can have an effect on the ocean. Ocean preservation does not make personal demands, as a general rule, and since the students are not required to indicate how they personally would behave in relation to any issue, positive responses may be given more freely. The attitude instrument as a whole, then, is probably measuring how students view mankind's relationship to the ocean, as opposed to measuring the depth of the students' own commitment to holding intact the natural systems involved.

Marine attitudes are probably positive across the general population as well as the school population sampled because of the nature of the ocean as a referent object. The ocean, for instance, is frequently used as a site for recreation, reflection, and relaxation. Its associated images are pleasant ones. Other referent topics in environmental literature, such as air quality or surface mining, produce negative images or may be of such a local nature that people respond with neutral opinions for lack of interest or information. Apparently even those people who have never seen the ocean (6.2 per cent of students in this study) know enough about it to have positive feelings toward it.

Feeling good about the ocean is hardly a reasonable basis for making rational decisions about whether coastal states should build deep-water ports to accommodate very large crude oil carriers, or whether landlocked nations should have unlimited access to the resources of the high seas. The development of a marine-literate

populace is a necessity that transcends the development of good feelings. In the words of Dr. Gilven Slonim (1970), president of the Oceanic Education Foundation,

> The United States future will be inextricably tied to the oceanic world. How well the nation rises to this challenge of the sea will depend ultimately on the enlightenment, the determination, the direction of its policy drive, and this is a function of how well its people understand the sea,...every single substantive aspect of the global sea's influence upon the human condition...For the United States must invest its energies and ingenuity, as well as additional educative resources, in multi-cultural, multidisciplinary oceanic education to sharpen its citizens' understanding of the world ocean. Once knowing [sic] their profound stake in the sea, their new knowledge will enrich their sense of the future destiny of this nation, which manifestly remains oceanic. (p. 6)

How, then, is the educative process best approached for development of both maximum knowledge and positive attitudes? Since this study has shown that there is a fairly strong positive relationship between attitudes and knowledge, both could be approached simultaneously. This study therefore, attempted to identify student experiences that might be related to either positive or high knowledge level. These experiences could provide a basis for recommending methods of effectively implementing marine education programs.

Since both coastal and inland students indicated that they had participated in marine-related activities to the same extent (with the exception of time actually spent at the beach) it appears that sheer numbers of experiences or high participation levels at the coast were not major factors related to marine knowledge and attitudes. When the students ranked ten types of experiences according to their perceived value in influencing knowledge and attitudes about the

oceans, television and movies were identified as the source of most of their marine information. Although regression analyses credited the rankings of these sources with explaining 4.2 per cent of the knowledge score variance, the individual experience item dealing with the number of Cousteau specials seen on television was shown to be significantly related to knowledge scores.

According to Dr. Peter Sandman (1978), author of many publications about the mass media and environmental education, people generally have difficulty identifying the source of their information. The influence of television is often overestimated because television is so dominant in people's lives. In this investigation, however, it appears that students have been accurate in their selection of television specials as being influential in increasing marine awareness. This is indicated by the size of the correlation coefficient between knowledge scores and the number of Cousteau specials seen. A typical Cousteau special includes not only marine information but an attitudinal element aimed at increasing awareness of the ocean as a threatened environment. It is likely that this combination, accessible to such a large audience, is a major influence on national marine awareness.

Dr. Sandman (1978) also postulates that

> ...both information and interest are probably cumulative and interactive; that is, the effect of a particular source may be dependent on other sources that are less visible/memorable. (p. 2)

In this regard it is possible to view some of the experiences related to marine knowledge and attitudes as parts of the broader influence

of socioeconomic level. This would be consistent with the fact that reading National Geographic is significantly related to knowledge level and that students with knowledge scores above 20 indicated extensive travel experience and participation in many recreational marine activities. It is likely that families of higher socioeconomic levels place a high value on personal enrichment and make available numerous and varied learning experiences.

With the possible background influence of socioeconomic status in mind, other demographic variables were examined for relationships to marine attitudes and knowledge. Mean knowledge scores were found to be significantly different with regard to race, sex, and residence (coastal or inland). In particular, coastal students scored higher than inland students, males scored higher than females, and whites scored higher than non-whites. Highest scores were made by white males from coastal schools. In the case of attitude scores, white coastal males exhibited the most positive attitudes, with all other white groups being moderately positive. Group means for attitude of non-whites approached neutrality across all sex and residence classifications.

There is evidence, then, that coastal males, and particularly white coastal males, have the highest level of marine awareness for the sample. If one were to speculate as to the reasons for this difference, several possibilities are evident. First, the socio-economic status data collected, while admittedly over-generalized and subject to the perception of the cooperating teacher, indicate 120 respondents were from coastal schools serving an upper

middle or upper class population. Only 28 inland students were from schools serving the upper middle class. It is likely that families of a higher socioeconomic status provide a greater number and variety of learning experiences for their children than is possible for lower income families. Higher coastal scores could in part be explained by the fact that a larger number of coastal school respondents were from upper or upper middle class families. In addition, coastal proximity obviously makes available a large number of varied marine-related experiences. Even if participation level is equivalent regardless of residence, the opportunities available favor males.

As for the differences in marine awareness based on race and sex, a knowledge survey in which 68 per cent of the questions are science based may create a bias toward science oriented students, most of which are white males. The marine related careers to which a student may aspire are also dominated by this group. This is not meant to imply that marine knowledge or marine occupations, or both, are science oriented, but the expertise of program directors and marine educators in general tends to produce such an image.

Because demographic variables themselves cannot ordinarily be manipulated, the educator seeking to increase marine awareness is faced with the task of overcoming such effects, if possible, by providing compensating experiences or by treating known awareness deficiencies directly. The involvement of minority groups in marine education should be approached in the same manner as their involvement in any other activity. Increasing overall educational attainment and awareness of marine-related opportunities in particular would be the logical

approach to resolving the differences noted (Schwaab, 1978). An examination of the subject matter surveyed in the knowledge section of the SOAK can provide the basis for some concrete recommendations concerning student marine knowledge. Data from Table 8 indicate that students are strongest in their knowledge of the ocean as a political interface, a chemical medium, and a threatened resource. The students scored lowest on items presenting the ocean as a cultural influence. The knowledge part of the SOAK provides a broad overview of the potential scope of marine education, and by examining specific item responses, a teacher could determine specific strengths and weaknesses of students as an indication of where to begin in teaching.

The overall performance level of about fifty per cent on knowledge scores may be credited largely to informal experiences. There was no significant relationship between any type of regular school class and students' knowledge and attitude scores. Even those students who had participated in a separate ocean study course (11.3 per cent of the sample) did not have scores that were significantly higher than the rest of the sample. A fifty per cent knowledge level across all topics measured is hardly grounds for self-congratulation. It indicates the need for inclusion of more marine information in some form in a planned educational setting, a setting designed to specifically increase knowledge, to heighten perceptions, or to foster positive attitudes.

Conclusions and Recommendations

The most important conclusions resulting from analyses of

survey responses were concerned with factors related to marine knowledge. Virginia's tenth graders have a fairly low level of knowledge about the ocean. This knowledge is greater in some areas of interest (physical science and social studies) than in others tested. It also varies with the race, sex, and place of residence of the respondent.

Students perceive marine-related television programs and movies to be the greatest influence on their knowledge about the ocean. While the combined effect of these variables accounts for only a small amount of the variation in knowledge scores, some specific experiences were identified as being capable of individually explaining larger proportions of the variation. The nature of these experiences and others identified by students scoring highest on marine knowledge leads one to believe that an underlying but here unidentified variable of socioeconomic status may be contributing to the acquisition of marine knowledge. Socioeconomic status may dictate, for example, not only whether a student has access to television, but also what programs are watched. Could a Cousteau television special take precedence over a favorite situation comedy or game show? To provide data for addressing such problems, future use of the Survey of Oceanic Attitudes and Knowledge should include some questions designed to generate specific information concerning the socioeconomic status of respondents.

If, on the other hand, one assumes that the experiences related to marine knowledge are indeed a direct influence on marine awareness, it is recommended that access to them be equalized across socioeconomic barriers by maximizing participation within the classroom. Many of Cousteau's television specials are available as 16 mm films

for classroom use. Likewise, the acquisition and reading of National Geographic articles need not be left to individual student enterprise. Classroom study of the materials, including projection of illustrations, clarification of vocabulary, and discussion of the meaning and importance of the subject being considered, could greatly increase the value of the journal as an instructional aid.

A further recommendation addresses the relationship between demographic characgeristics and marine knowledge and attitudes. Science, marine recreation, and marine careers currently appear to favor white males. In order to encourage the entry and participation of other groups in these areas, a deliberate attempt should be made to increase student awareness of the potential for greater involvement of females and non-whites in marine experiences. Guest speakers, visual aids, and the vocabulary of discussions in general should be utilized in such a way as to reflect an "equal opportunity, affirmative action" approach.

A final substantive recommendation involves utilization of the data from Table 8. This investigation has approached marine education as a multidisciplinary topic rather than as a branch of science exclusively. The data suggest that some improvement in the level of student knowledge about the ocean is desirable, and specific ocean study courses have not been shown to be significantly related to marine knowledge or attitudes. On the basis of this information, it is recommended that subject matter dealing with the ocean be infused into existing curricula in order to increase awareness of what Slonim (1977) has termed "the integrative humanities of our world sea."

> Perhaps with a broader view, one which focuses on oceans and coastal areas, and all their important contributions to man—commerce, food, recreation, energy—"marine" education... can make a contribution to the political process so crucial to the future of the coasts and oceans, and of man. (Jacobius, 1977, p. 1)

In anticipation of the use of the Survey of Oceanic Attitudes and Knowledge for extending and refining the relationships reported in this dissertation, the following improvements should be made. Format changes in the survey instrument itself and in its administration could provide a more comprehensive look at marine knowledge. It is recommended that future administrations of the survey be extended to occupy two class periods at the possible expense of some portion of the response rate. The first class period would be devoted to the collection of demographic data and responses to the Marine Experience Profile. All three knowledge forms should be combined into a single test and administered along with the attitude survey during the second class period.

The technique of attempting to identify specific knowledge-related experiences could be enhanced by experiments involving the value of certain experiences in a pretest-posttest design. Methods could also be improved and expanded by testing in a standard curriculum course. For example, what earth science experiences outside of class are related to high scores on geology tests?

Finally, the possibility that knowledge level in general is related to performance on marine knowledge tests should be investigated. Scores from standardized achievement tests, for example, could be compared with marine knowledge scores to provide this information.

As for attitudes, this study provides evidence that most of Virginia's tenth graders express positive attitudes toward marine issues, with higher knowledge levels being associated with more positive marine attitudes. As in the case of marine knowledge, marine attitudes vary somewhat with the race, sex, and place of residence of respondents. Attitudes, however, do not appear to be related to any specific experience students have had.

The possible advantages of coastal proximity were evident in both the higher knowledge and attitude scores of the coastal subsample. If students over a much larger geographic area were surveyed, it would be possible to compare results for coastal and inland states, as well as for other subgroups of the United States population such as rural versus urban or east coast versus west coast samples. Additional data from these larger samples could make it possible to state with greater certainty whether racial effects are of practical significance and whether coastal proximity per se or other variables contingent upon or arising from place of residence are related to marine knowledge or attitudes.

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APPENDIX A.

LIST OF COOPERATING SCHOOLS

COOPERATING SCHOOLS

Coastal Schools	Location	Sample Size
Bishop Denis O'Connell High School	Arlington, VA	34
Cradock High School	Portsmouth, VA	27
Forest Glen High School	Suffolk, VA	25
Frank W. Cox High School	Virginia Beach, VA	22
George Mason High School	Falls Church, VA	17
Groveton High School	Alexandria, VA	33
Indian River High School	Chesapeake, VA	29
J. R. Tucker High School	Richmond, VA	41
Norfolk Academy	Norfolk, VA	30
Onancock High School	Onancock, VA	19
Quantico High School	Quantico, VA	31
Southampton High School	Courtland, VA	30
Spotsylvania High School	Spotsylvania, VA	23
Windsor High School	Windsor, VA	33
Woodson High School	Fairfax, VA	26

Inland Schools	Location	Sample Size
Cave Spring High School	Roanoke, VA	21
Central High School	Victoria, VA	25
Chatham Hall	Chatham, VA	7
Clarke County High School	Berryville, VA	22
Drewry Mason High School	Ridgeway, VA	25
Franklin County High School	Rocky Mount, VA	30
George Wythe High School	Wytheville, VA	21
Heritage High School	Lynchburg, VA	18
J. J. Kelly High School	Wise, VA	43
Marion High School	Marion, VA	26
Massanutten Academy	Woodstock, VA	14
Park View High School	South Hill, VA	31
Shawsville High School	Shawsville, VA	24

COOPERATING SCHOOLS
(Continued)

Inland Schools (Continued)	Location	Sample Size
Twin Springs High School	Nickelsville, VA	26
Turner Ashby High School	Dayton, VA	34

APPENDIX B.

ORIGIN AND DISTRIBUTION OF ATTITUDE AND KNOWLEDGE ITEMS

Sources of Attitude Items
SOAK: Part II

Item	Source
51	Author
52	Author
53	Author
54	Author
55	Howe and Price, 1976
56	Author
57	Author
58	Author
59	Richmond, 1976; Author
60	Richmond, 1976
61	Author
62	Author
63	Author
64	Author
65	Author

DISTRIBUTION OF KNOWLEDGE ITEMS
SOAK: PART III

Item Categories	Item Numbers		
The ocean as a:	Form A	Form B	Form C
Chemical medium	67, 74, 80	67, 79, 89	67, 74, 85
Physical system	66, 73, 78, 84, 88	66, 72, 77, 81, 85	66, 73, 81, 84, 88
Biological community	70, 72, 77, 83, 90	70, 80, 84, 88, 90	70, 72, 79, 80, 90
Political interface	68, 81, 87	68, 74, 78	68, 76, 87
Cultural influence	69, 75, 79, 85, 89	69, 73, 76, 82, 87	69, 75, 78, 82, 86
Threatened resource	71, 76, 82, 86	71, 75, 83, 86	71, 77, 83, 89

Sources of Knowledge Items and Answers
SOAK: Part III

Item	Question Source	Answer Source	Page(s)
66	Author	Anikouchine and Sternberg, 1973	10
67	Author	Anikouchine and Sternberg, 1973	55
68	Author	Goodwin, 1977	14
69	Author	Cousteau, 1973c	16
70	Leek, 1977	Odum, 1971	360
71	Author	Pope, 1978	8
A72	Howe and Price, 1976	Odum, 1971	331
A73	Howe and Price, 1976	Anikouchine and Sternberg, 1973	35
A74	Author	Odum, 1971	26
A75	Howe and Price, 1976	Coleridge, 1970 (1834)	20
A76	Author	Brown, 1978	19
A77	Leek, 1977; Author	Odum, 1971	63
A78	Howe and Price, 1976	Delury, 1976	485
A79	Author	Bartlett, 1953	Index
A80	Leek, 1977	Anikouchine and Sternberg, 1973	94
A81	Author	National Oceanic and Atmospheric Administration, 1975	2
A82	Author	Department of the Army, 1976	58
A83	Leek, 1977	Core, et al., 1961	394
A84	Leek, 1977	Anikouchine and Sternberg, 1973	175
A85	Author	Laing, 1974	297-300
A86	Author	Regenstein, 1975	50-51
A87	Howe and Price, 1976; Author	Mostert, 1974	58
A88	Howe and Price, 1976	Anikouchine and Sternberg, 1973	82
A89	Author	Laing, 1974	180-181
A90	Howe and Price, 1976	Lineaweaver and Backus, 1970	48
B72	Howe and Price, 1976	Delury, 1976	440
B73	Author	Kipling, 1897	all
B74	Author	Delury, 1976	485
B75	Richmond, 1976	Idyll, 1970a	36-45
B76	Author	Laing, 1974	158
B77	Leek, 1977	Gross, 1971	82-83
B78	Richmond, 1976	Bureau of Mines, 1975	6
B79	Author	Cousteau, 1973a	72

Item	Question Source	Answer Source	Page(s)
B80	Hounshell and Liggett, 1973	Odum, 1971	349
B81	Leek, 1977	Anikouchine and Sternberg, 1973	127
B82	Author	Earth Science Curriculum Project, 1968	238
B83	Howe and Price, 1976; Author	Mangone, 1977	85
B84	Author	Warner, 1976	xii
B85	Howe and Price, 1976	Earth Science Curriculum Project, 1968	239
B86	Author	"Oil is pouring on troubled waters"	45
B87	Author	Heyerdahl, 1971	320-323
B88	Author	Anikouchine and Sternberg, 1973	207
B89	Author	Anikouchine and Sternberg, 1973	74-75
B90	Howe and Price, 1976	Odum, 1971	299
C72	Author	Anikouchine and Sternberg, 1973	202
C73	Howe and Price, 1976	Earth Science Curriculum Project, 1968	63-65
C74	Howe and Price, 1976	Cousteau, 1973b	61
C75	Author	Lewis, 1960	212
C76	Author	Delury, 1976	488
C77	Richmond, 1976	American Nuclear Society, 1974	16-19
C78	Author	Hemingway, 1952	
C79	Author	Anikouchine and Sternberg, 1973	195
C80	Leek, 1977	Biological Sciences Curriculum Study, 1968	83-88
C81	Author	Weyl, 1970	296-299
C82	Author	Weyl, 1970	43-49
C83	Howe and Price, 1976	Idyll, 1970b	3, 12
C84	Author	Berlitz, 1974	36
C85	Howe and Price, 1976	Gross, 1971	64
C86	Author	Hedgpeth, 1977	30-31
C87	Author	"The battle of the barrels begins", 1977	69
C88	Leek, 1977	Gross, 1971	113
C89	Author	Paine, 1977	9
C90	Howe and Price, 1976	Fong and Stokes, 1977	64

APPENDIX C.

PANEL OF INSTRUMENT REVIEWERS

PANEL OF INSTRUMENT REVIEWERS

Doctoral Committee Members

Dr. Thomas G. Teates	Director and Associate Professor Division of Curriculum and Instruction College of Education, VPI & SU
Dr. Karl E. Schwaab	Assistant Professor (Environmental Education) College of Education, VPI & SU
Dr. Terry M. Wildman	Assistant Professor (Educational Psychology) College of Education, VPI & SU
Dr. Ernest F. Benfield	Associate Professor (Biology) College of Arts and Science, VPI & SU
Dr. R. Wesley Batten	Director Mathematics and Science Center Glen Allen, Virginia

Other Reviewers

Dr. Joseph Exline	Assistant Science Supervisor Virginia Department of Education Richmond, Virginia
Ms. Mary Frederick	Coordinator, Precollege Oceanography Program Marine Science Consortium Wallops Island, Virginia
Mrs. Mary Frances Graham	Biology and Oceanography Teacher Ferguson High School Newport News, Virginia
Mrs. Ellen Holtman	Biology Teacher Cave Spring High School Roanoke, Virginia
Dr. Thomas Krakauer	Director Roanoke Valley Science Museum Roanoke, Virginia

PANEL OF INSTRUMENT REVIEWERS
(Continued)

Other Reviewers (Continued)

Mr. James Lanier	Head, Marine Education Program Virginia Institute of Marine Science Gloucester Point, Virginia
Dr. George Simmons	Associate Professor of Zoology VPI & SU Blacksburg, Virginia

APPENDIX D.

SURVEY OF OCEANIC ATTITUDES AND KNOWLEDGE (KEYED)

SURVEY OF OCEANIC ATTITUDES AND KNOWLEDGE

SOAK: PART I
MARINE EXPERIENCE PROFILE

Below is a list of activities that have helped some people learn about the ocean. Please indicate which of the experiences you have had. At the end of Part I you will be asked to rate each type of experience as to how important it has been to your learning about the ocean.

Mark all your answers on the answer sheet in the numbered space that corresponds to your answer. For example, if a question says

X1. Have you ever gone clam digging? 1) yes 2) no

and you do this fairly often, or have done it once at least, you would mark on your answer sheet:

X1. ● ② ③ ④ ⑤

Read the instructions for each part of the survey carefully. If you wish to change any of your answers, be sure to erase your original answer completely.

BEGIN

Have you seen any of these movies?

1.	Jaws	(1) yes	(2) no
2.	The Deep	(1) yes	(2) no
3.	Orca	(1) yes	(2) no
4.	Blue Water, White Death	(1) yes	(2) no
5.	Shark's Treasure	(1) yes	(2) no
6.	Neptune Factor	(1) yes	(2) no
7.	20,000 Leagues Under the Sea	(1) yes	(2) no
8.	Tentacles	(1) yes	(2) no

In Questions 9-11, tell whether you watch each television series

(1) always
(2) usually
(3) seldom
(4) never

9. Wild, Wild World of Animals

10. Man from Atlantis

11. Wild Kingdom

12. How many Jacques Cousteau specials have you seen on television?

(1) all of them
(2) 3 to 5
(3) 1 or 2
(4) none

13. How much have you learned about the ocean from television news programs?

(1) nothing
(2) a few things
(3) quite a bit
(4) most of what I know about the ocean

For each of the magazines in Questions 14-19, tell whether you read it

(1) always
(2) usually
(3) sometimes
(4) never

14. National Geographic

15. Sea Frontiers

16. Science World

17. Oceans

18. National Wildlife

19. Natural History

20. Have you learned anything about the ocean from a newspaper?

(1) yes (2) no

21. How many books have you read about the ocean in the last two years?

(1) more than 10 books
(2) 4 to 10 books
(3) 1 to 3 books
(4) none

22. Have you ever lived within 50 miles of the ocean.

(1) yes, for much of my life
(2) yes, for 2-5 years
(3) yes, for about a year
(4) no, never

23. How many times did you go to an ocean beach last year?

(1) once a month or more often
(2) 2 to 10 separate trips
(3) one trip
(4) did not go last year
(5) have never been to an ocean beach

24. How frequently do you usually go on a boat to travel, fish, cruise, relax, etc., on the ocean?

(1) more than 10 times a year
(2) 5 to 9 times a year
(3) 1 to 4 times a year
(4) usually do not go out on a boat
(5) have never been on a boat in the ocean

25. How well can you swim?

(1) I can swim at least 1000 yards (10 football fields).
(2) I can swim at least 100 yards (1 football field).
(3) I can swim at least 50 yards.
(4) I can swim, but not 50 yards.
(5) I cannot swim.

If you could have your choice, would you live in an area

26. near a river or lake (1) yes (2) no

27. near the ocean (1) yes (2) no

28. away from bodies of water (1) yes (2) no

Have you ever:

29. Been scuba diving or snorkeling? (1) yes (2) no

30. Been fishing in the ocean? (1) yes (2) no

31. Made a seashell collection? (1) yes (2) no

32. Attended an organized Sea Camp? (1) yes (2) no

33. Been a Sea Explorer? (1) yes (2) no

Have you ever visited any of the following?

34. Sea World (1) yes (2) no

35. Marineland (1) yes (2) no

36. New England Aquarium (1) yes (2) no

37. Mystic Seaport or Aquarium (1) yes (2) no

38. National Aquarium (1) yes (2) no

39. Museum of Natural History (1) yes (2) no

40. Mariners Museum (1) yes (2) no

41. Roanoke Valley Science Museum (1) yes (2) no

42. Would you like to learn more about the oceans?

(1) yes (2) no

43. Are you interested in a career related to the oceans?

(1) yes (2) no

44. Have you ever taken a separate class in oceanography, marine biology, or a related ocean subject?

(1) yes (2) no

For Questions 45-50, try to recall which of your own middle school, junior high, or high school classes have involved ocean study.

For each of the classes listed in 45-50, tell how much time was spent in studies about some aspect of the oceans, using these choices:

(1) more than a month
(2) 2 to 4 weeks
(3) one week or less
(4) no time
(5) did not take the class

45. Life Science (7th grade)

46. Earth/Space Science

47. Biology

48. Social Studies (geography, history, etc.)

49. English or Language Arts

50. All other junior high and high school classes put together

THIS IS THE MOST IMPORTANT SECTION OF PART I.

The experiences you have just identified are grouped below into 10 categories. Keeping in mind the questions you have answered up to now, please RANK the 10 in order of their importance in helping you learn about the oceans.

A. Use the answer sheet spaces numbered 101 to 110.

B. In the list below, find the experience you consider most important, and mark it as a 10 on your answer sheet.

C. Find the next most important experience, and mark it 9 on the answer sheet.

D. Continue in this manner until you reach the experience category you consider to be the least important, and mark it 1.

E. Use each number, 1-10, only once in your answers for this section.

101. Movies

102. Television specials

103. Newspapers and tv news

104. Magazines

105. Regular school classes

106. Ocean study class

107. Books (outside of school)

108. Recreational activities at the beach

109. Educational activities at the beach

110. Visits to public aquaria, etc.

SOAK: PART II
ATTITUDES

There are no "right" answers to this part of the survey. For statements 51-65, choose your answers from this list:

(1) definitely agree
(2) tend to agree
(3) tend to disagree
(4) definitely disagree

Example: X2. Near a beach is the best place to live.

If you definitely agree or disagree with this statement, mark answer 1 or 4 accordingly. If you aren't sure how you feel, choose the answer which comes closest to your feelings at the present time.

51. The resources of the oceans are insignificant compared to the resources of the land masses.

52. Some unusual or delicate coastal environments should be off-limits to the public.

53. The government should not have the right to regulate the fishing industry.

54. The ocean is so vast that pollution has practically no effect on it.

55. The United States should spend more money to increase food production from the sea.

56. Coastal wetlands (marshes and such) should be filled in to provide more land for homes near the coast.

57. If sharks became extinct, the world would be a lot better off.

58. Ocean trenches would be a good place to dispose of the wastes from our cities.

59. The oceans represent only a limited source of food and resources for the future.

60. There should be an international agreement about some form of punishment for industries and oil tankers that pollute the ocean.

01. We should ban tuna fishing in order to protect porpoises, which are sometimes accidentally caught in tuna nets.

02. Offshore oil resources cannot be exploited without permanent damage to the ocean environment.

03. Owners of beach homes and motels should be allowed to fence off sections of beach for their private use.

04. Some sections of seashore should be set aside just for people's personal enjoyment.

05. A person living 500 miles inland would not be affected by the ocean.

SOAK: PART III
KNOWLEDGE SURVEY

In this section of the SOAK there is only one right answer for each question. Read each question carefully and choose the answer you feel is the best. Mark your answer sheet as shown in the example below:

Example: X3. Which of the following is the greatest tide-producing force for the world's oceans?

(1) sun
(2) moon
(3) planets
(4) stars

Since the correct answer is (2) moon, you should mark your answer sheet:

X3. ①●③④⑤

Remember to erase completely if you make changes on your answer sheet.

BEGIN

66. What percent of the earth's surface is covered by oceans?

(1) 40
(2) 50
(3) 60
*(4) 70

67. Every naturally-occurring element is present to some extent in sea water.

*(1) true (2) false

68. The United States has extended its economic boundary to a distance of ? miles offshore.

(1) 3
(2) 12
(3) 100
*(4) 200

69. In mythology the Roman god of the sea was

(1) Apollo
*(2) Neptune
(3) Demeter
(4) Zeus

70. The greatest production of organic matter would be found in one square kilometer of

(1) open ocean
(2) mud flat
*(3) salt marsh
(4) sand dune

71. Large quantities of oil have been found on the continental shelf off the coast of Virginia.

(1) true *(2) false

A72. The primary producer in the marine food chain consists of

(1) zooplankton
(2) small fish
*(3) phytoplankton
(4) invertebrates

A73. There is evidence that the North American continent has

(1) never moved and probably will not move
(2) moved in the past, but is not moving now
(3) not moved, but could move
*(4) moved in the past and is presently moving

A74. When organic wastes are broken down in water, what substance is removed from the water?

(1) carbon dioxide
*(2) oxygen
(3) hydrogen
(4) ammonia

A75. In the statement, "Water, water everywhere and not a drop to drink," the poet was referring to

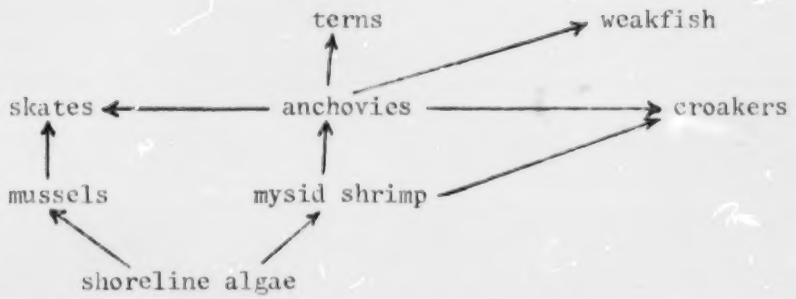
*(1) sea water
(2) rain water
(3) polluted water
(4) a flood

A76. The harvest and sale of some food organisms from the Chesapeake Bay has been stopped because these organisms contain unacceptable levels of

(1) DDT
(2) lead
(3) mercury
*(4) kepone

A77. In the following food web, the top carnivores are

(1) terns and weakfish
(2) anchovies and croakers
*(3) skates, terns and weakfish
(4) croakers and skates



A78. The amount of land surface in the Northern Hemisphere is

(1) considerably less than the land surface in the Southern Hemisphere
(2) about the same as the land surface in the Southern Hemisphere
*(3) considerably greater than the land surface in the Southern Hemisphere

A79. The English language contains many familiar expressions that originated as sayings about the sea. Which of the following is <u>not</u> one of these sayings?

(1) Time and tide wait for no man.
*(2) As fickle as a fishwife
(3) Any old port in a storm
(4) Red sky at night, sailors delight.

A80. Surface seawater is saltiest where

(1) precipitation is high and evaporation is low
*(2) evaporation is high and precipitation is low
(3) precipitation equals evaporation
(4) there is no evaporation or precipitation

A81. The U.S. Government agency concerned with the study of the oceans is

*(1) NOAA
(2) EPA
(3) NASA
(4) CIA

A82. Supertankers carrying oil do not come to Virginia at present because

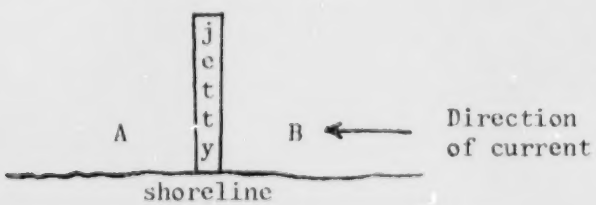
(1) there are no deepwater ports for them
(2) they cannot go across the Chesapeake Bay Bridge-Tunnel
(3) major refineries and pipelines are not located here
*(4) all of the above

A83. A typical marine fish possesses a swim bladder which enables it to adjust to limited changes in

(1) oxygen content
(2) metabolic waste products
*(3) pressure
(4) salt concentrations

A84. As seen from above, the jetty in the following picture will cause

(1) sand to build up at side A and erode at side B
*(2) sand to erode from side A and build up at side B
(3) erosion to occur on both sides
(4) sand to build up on both sides



A85. The Monitor was

(1) the first U.S. nuclear submarine
(2) a ship aboard which a famous treaty was signed

*(3) an ironclad warship in the Civil War
(4) the first ship destroyed at Pearl Harbor

A86. The group of sea animals that contains the largest number of threatened or endangered species is

(1) fish
(2) mollusks
(3) echinoderms
*(4) mammals

A87. Many oil tankers fly the flags of a few small countries like Liberia because these countries

(1) are great oil producers
*(2) have weaker shipping regulations
(3) are politically neutral
(4) have the biggest ships

A88. Daily temperature changes in ocean waters at one location are

*(1) much less than in air
(2) about the same as in air
(3) much more than in air

A89. Scrimshaw was

(1) one of the "tall ships" in the Bicentennial
(2) the type of writing found in the Dead Sea Scrolls
(3) a series of knots used in sail riggings
*(4) the whalers' art of carving on whale teeth and bones

A90. Sharks frequently attack swimmers along our shore.

(1) true *(2) false

STOP.

Turn in your survey form and answer sheet to your teacher. Make sure your answer sheet has the proper Test Form letter marked on it.

Thank you for your cooperation.

B72. The deepest ocean trenches currently known are in the

(1) Atlantic Ocean
(2) Indian Ocean
*(3) Pacific Ocean
(4) Mediterranean Sea

B73. Which of the following stories does not take place on an island?

(1) Robinson Crusoe
(2) Swiss Family Robinson
*(3) Captains Courageous
(4) Hawaii

B74. Which of the following nations has no seacoast?

(1) France
*(2) Tibet
(3) Guatemala
(4) Algeria

B75. Several species of whales have become endangered because of

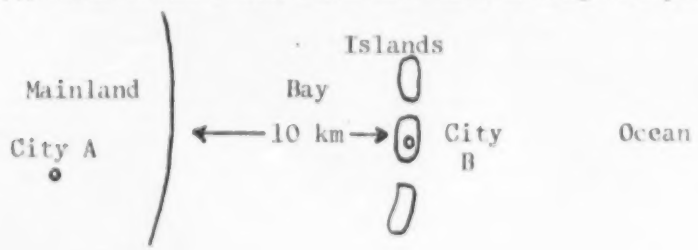
(1) pollution of the oceans by industrial wastes
(2) oil spills from tankers and offshore drilling
(3) a reduction in their food supply
*(4) commercial harvesting by man

B76. To keep the rhythm of the oars, or to pull together in raising the sails, the crew of an early sailing ship would sing songs called

*(1) chanteys
(2) carols
(3) timers
(4) canticles

B77. If the figure below represents an area off the coast of Virginia,

(1) City A will have the cooler average temperature in summer
*(2) City B will have the warmer average temperature in winter
(3) both cities will have the same average temperature in winter
(4) both cities will have the same average temperature in summer



B78. Natural resources are equally distributed across the face of the globe.

(1) true *(2) false

B79. Marine phytoplankton are responsible for producing __?__ of the earth's oxygen.

(1) 1/10
(2) 1/4
*(3) 2/3 or more
(4) 100%

B80. Green plants do not grow at great depths in the ocean because

(1) the water pressure is too great
(2) oxygen and carbon dioxide are not found at these depths
(3) the water temperature is too cold
*(4) sunlight does not penetrate to great ocean depths

B81. A large earthquake might cause a __?__ in the ocean.

(1) large-scale ocean current
*(2) tsunami (tidal wave)
(3) poisonous red tide
(4) change in fish migration

B82. Who first charted the path of the Gulf Stream?

(1) Christopher Columbus
(2) Vasco DaGama
(3) Matthew Fontaine Maury
*(4) Benjamin Franklin

B83. Approximately what percent of the U.S. population lives within 50 miles of the coast?

(1) 10%
(2) 30%
*(3) 60%
(4) 90%

B84. Which of the following is an economically important product of the Chesapeake Bay?

(1) tuna
(2) lobsters
*(3) blue crabs
(4) squid

B85. Major surface currents of the ocean move

(1) clockwise in both the Northern and Southern Hemispheres
(2) counter-clockwise in both the Northern and Southern Hemispheres
*(3) clockwise in the Northern Hemisphere and counter-clockwise in the Southern Hemisphere
(4) counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere

B86. Most oil pollution in the ocean comes from

*(1) routine ship maintenance in port
(2) breaks in underwater pipelines
(3) damaged oil tankers
(4) leaks in offshore oil wells

B87. The "Ra Expeditions" indicated that

*(1) early men could have traveled great distances in reed boats
(2) reed boats were not suitable for sea travel
(3) the Indies could be reached by sailing eastward
(4) it was possible to sail around Cape Horn

B88. The animal group that has no land or fresh-water members is the

(1) sponges
(2) mollusks
*(3) echinoderms
(4) coelenterates

B89. Sea water freezes at

(1) $0^{\circ}C$ ($32^{\circ}F$)
(2) temperatures higher than $0^{\circ}C$
*(3) temperatures lower than $0^{\circ}C$
(4) none of the above. Sea water does not freeze.

B90. Most species of fish found in lakes and rivers are also found in the ocean.

(1) true *(2) false

STOP.

Make sure your answer sheet has a Test Form letter marked on it. Turn your survey paper and answer sheet in to your teacher. Thank you for your cooperation.

C72. Most edible shellfish are found in areas of

*(1) shallow coastal waters
(2) deep ocean waters
(3) fresh-water marshes
(4) very salty waters

C73. Distance or position north or south of the equator is called

*(1) latitude
(2) longitude
(3) leagues

C74. The condition known as the "bends" results when a person is subjected to

(1) a sudden increase in pressure
*(2) a sudden decrease in pressure
(3) air containing too little nitrogen
(4) air containing too much nitrogen

C75. You are taking this test in the English language because

(1) Henry VIII made this our official language
*(2) the Spanish Armada was defeated by England
(3) the United States won the Revolutionary War
(4) the Pope's Line of Demarcation gave North America to England

C76. Which of the following states has no seacoast?

(1) New Hampshire
*(2) Idaho
(3) Mississippi
(4) Texas

C77. Nuclear power plants are usually built near bodies of water because the water is

(1) an added safety factor in case of a radiation leak
*(2) used to cool the reactors
(3) an alternative power source
(4) a disposal place for radioactive wastes

C78. In Hemingway's The Old Man and the Sea, the main character returns to por. with

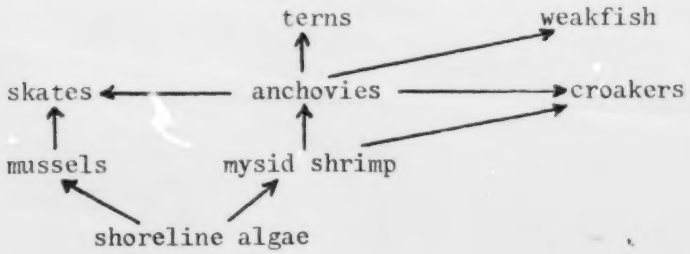
(1) the biggest fish anyone had ever seen
(2) a treasure worth millions of dollars
*(3) a huge fish skeleton
(4) a boat full of two-pound lobsters

C79. Red tides are caused by

(1) shark feeding frenzies
(2) millions of floating dead fish
*(3) a type of plankton
(4) refraction of sun rays at a certain angle

C80. In the food web shown, direct competitors for food would be

(1) skates and mysid shrimp
*(2) croakers and weakfish
(3) terns and anchovies
(4) weakfish and anchovies



C81. The Mid-Atlantic Ridge is

*(1) a site for sea-floor spreading
(2) the remains of an ancient land mountain range
(3) one of the oldest parts of the sea floor
(4) the remains of an old coral reef

C82. The first great body of scientific information about the sea came from the voyages of the ? in the nineteenth century.

*(1) Challenger
(2) Trieste
(3) Beagle
(4) Calypso

C83. How did the amount of fish (in pounds) caught in the ocean in 1970 compare to the catch in 1950?

(1) The 1970 catch was about $\frac{1}{2}$ the 1950 catch.
(2) They were about the same.
*(3) The 1970 catch was more than double the 1950 catch.

C84. The Bermuda Triangle is located

(1) in the Caribbean Sea
(2) in the Gulf of Mexico
(3) in the South Pacific
*(4) off the coast of the Carolinas

C85. Sea water has a density

*(1) greater than that of fresh water
(2) less than that of fresh water
(3) the same as that of fresh water

C86. Which of the following painters is famous for his pictures of watermen at work?

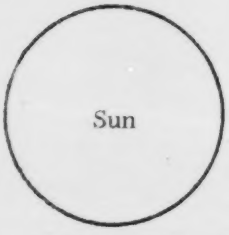
*(1) Winslow Homer
(2) Matthew Brady
(3) Paul Cezanne
(4) Pablo Picasso

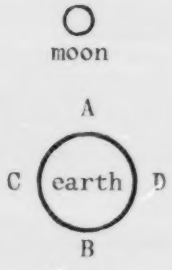
C87. OPEC is the

*(1) Organization of Petroleum Exporting Countries
(2) Organization of Powerful Eastern Countries
(3) Oil Producers of the European Community
(4) Overseas Policy on Economic Control

C88. In the figure below, the highest tides are at points

*(1) A and B
(2) A and C
(3) B and D
(4) C and D





C89. The <u>Argo Merchant</u> was

(1) the hero of an ancient epic sea poem
*(2) an oil tanker that wrecked off Cape Cod
(3) a trading ship that found a route to the Orient
(4) a famous Dutch trader

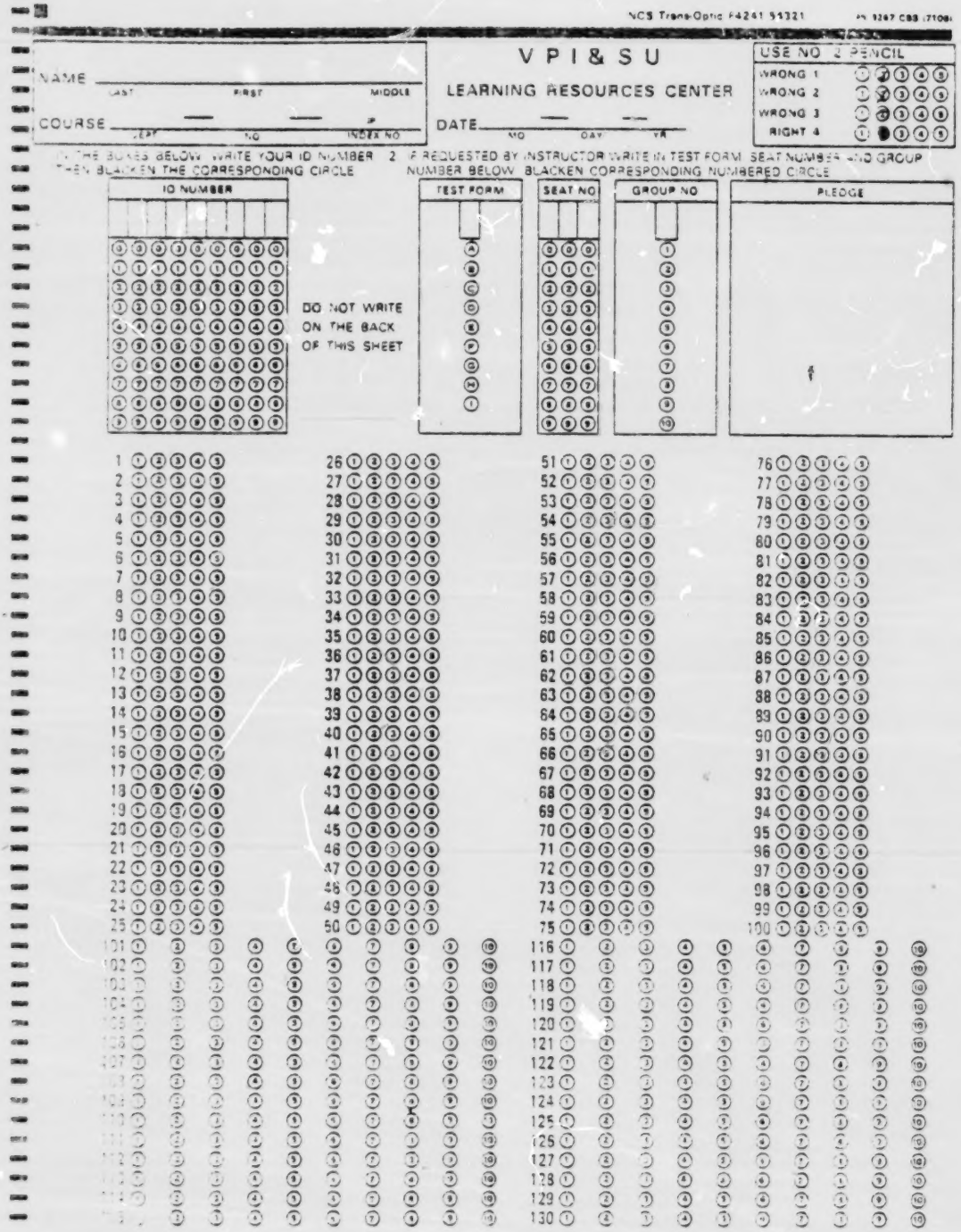
C90. Many fish are a good food for people on fat restricted diets because the fish contain low amounts of saturated fats.

*(1) true (2) false

STOP.

Make sure your answer sheet has a Test Form letter marked on it. Turn in your survey paper and answer sheet to your teacher.

Thank you for your cooperation.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V P I & S U
LEARNING RESOURCES CENTER
NAME
LAST
FIRST
MIDDLE
COURSE
DEPT
NO
SECT
INDEX NO
DATE
MO
DAY
YR
USE NO. 2 PENCIL
WRONG 1
WRONG 2
WRONG 3
RIGHT 4
IN THE BOXES BELOW WRITE YOUR ID NUMBER THEN BLACKEN THE CORRESPONDING CIRCLE
IF REQUESTED BY INSTRUCTOR WRITE IN TEST FORM SEAT NUMBER AND GROUP NUMBER BELOW BLACKEN CORRESPONDING NUMBERED CIRCLE
ID NUMBER
DO NOT WRITE ON THE BACK OF THIS SHEET
TEST FORM
SEAT NO
GROUP NO
PLEDGE

APPENDIX E.

LETTERS OF TRANSMITTAL TO PRINCIPALS AND COOPERATING TEACHERS

COLLEGE OF EDUCATION

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

DIVISION OF CURRICULUM AND INSTRUCTION

December 6, 1978

Dear (Principal):

The trends of increasing concern about the condition of our water resources and a growing interest in our maritime heritage have led many educators to believe that the world of water should receive greater emphasis in the formal educational process. At present, however, there are no concrete data to indicate whether or not such emphasis is necessary. Before any recommendations can be made, we need the answers to several questions:

What do our students know about the marine environment and its impact on our culture?

How do students feel about the importance of the oceans and the manner in which we use them?

Did the students acquire their marine knowledge and attitudes at school or as a result of some other set of experiences?

In order to find the answers to these questions we are inviting your school to participate in a research study along with 29 other schools statewide. We propose to ask thirty tenth graders in your school some written questions about the ocean and their own marine-related experiences. This would require one class period only at the beginning of your second semester. It would involve no expense to your school.

Should you decide to participate, please choose a class in your school that is likely to contain students representing the full range of ability levels in your school. They must all be tenth graders, but the class they are in can be any subject. The survey includes some science questions but many in social studies and the arts as well, so we would like to avoid stereotyping it as a science test.

Enclosed is a self-addressed postcard on which you may indicate your decision. We realize this is a busy time in your schedule, but a reply before January 6 would be greatly appreciated.

Thank you for your cooperation.

Sincerely,

Rosanne Fortner

Mrs. Rosanne Fortner
Graduate Teaching Assistant

T. G. Teates

Dr. T. G. Teates
Director, Division of
Curriculum and Instruction

COLLEGE OF EDUCATION

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

DIVISION OF CURRICULUM AND INSTRUCTION

Dear (Teacher):

Your principal has agreed to have your school participate in a statewide survey we are conducting, and he has named you to be our cooperating teacher. In case you are uncertain about what is involved, let me explain briefly. The survey is called "SOAK," for Survey of Oceanic Attitudes and Knowledge, and it has three parts designed to determine (1) what students know about the ocean, (2) how they feel about the ocean's importance and the way we use the ocean, and (3) the experiences that led the students to this knowledge level and attitude set.

In order to administer this survey, we are asking you to present it to one of your classes which has only tenth graders of varied ability levels. A class of about 30 would be ideal, but five or six more or less can be compensated for by the samples in other schools. Please take a moment now to fill in the enclosed post card telling us how many copies of the survey materials you will need. By January 16 we will put in the mail for you this number of survey forms, answer sheets, and pencils embossed with the SOAK-78 logo. The parcel will also contain complete instructions for administering the survey, and a stamped envelope for the return of the answer sheets. The survey is to be given during a single class period at the beginning of your second semester, or at least by February 10.

If you have questions about the survey that remain unanswered, please write them on the post card and we will respond promptly. Thank you for your assistance.

Sincerely,

Rosanne Fortner

Mrs. Rosanne Fortner
Graduate Teaching Assistant

POSTCARDS PROVIDED FOR REPLIES FROM
PRINCIPALS AND COOPERATING TEACHERS

School _____

_____ Yes, our school will participate in the marine awareness survey.

Send materials to _____
(cooperating teacher)

_____ No, our school chooses not to participate in this study.

_____
Principal's signature

Cooperating Teacher_____

School_____

Number of Survey Packets Needed_____

APPENDIX F.

INSTRUCTIONS TO TEACHERS AND GENERAL INFORMATION FORM

INSTRUCTIONS FOR TEACHERS

1. Fill in the "General Information" sheet enclosed.
2. Distribute the blue pencils for marking answers. Students may keep the pencils when the survey is completed.
3. Distribute answer sheets. Caution students not to bend or wrinkle them, as the computer will spit them out and score them as zero!
4. On the answer sheets, instruct students as follows:
   a. "Use only the pencils provided for marking on this sheet."
   b. "Fill in today's date in the blanks at the top of the sheet."
   c. "Notice in the top right corner the correct method for marking your answers on this answer sheet: fill in the entire circle corresponding to the answer you have chosen."
   d. "Below the spaces marked DATE, find the section labelled SEAT NO. In the first column under SEAT NO., blacken in the ⓪ if you are a male student, and the ① if you are a female student."
   e. "In the second column under SEAT NO., blacken in the circle for the racial group to which you belong. Your choices are:

      (1) Black (4) Spanish-American
      (2) White (5) American Indian
      (3) Oriental (6) Other

   f. "Under the section called GROUP NO., blacken in circle ①."
   g. "It is not necessary to put your name on the answer sheet, but you may if you wish."
5. Distribute the survey booklets. On the front of each is a black letter A, B, or C. Have the students blacken in the circle under TEST FORM according to the survey they have.

   THIS STEP IS ESSENTIAL!

   Do not continue until all students have completed this step. Each form of the knowledge test has different answers, so responses cannot be scored without the form letter.
6. Instruct students to read all instructions for each part carefully and mark all their answers in the manner shown. Only Part III of the survey, the Knowledge section, has right and wrong answers.
7. Students may work straight through the survey to the end. Please allow the entire class period for completion. Collect all the answer sheets when students have finished, <u>making sure each sheet has a form letter marked on it</u>.
8. Return the answer sheets and "General Information" sheet in the envelope provided.

Thank you for your assistance.

Mrs. Rosanne Fortner
307 War Memorial Gym
College of Education, VPI & SU
Blacksburg, VA 24061

INSTRUCTIONS FOR TEACHERS

1. Fill in the "General Information" sheet enclosed.
2. Distribute the blue pencils for marking answers. Students may keep the pencils when the survey is completed.
3. Distribute answer sheets. Caution students not to bend or wrinkle them, as the computer will spit them out and score them as zero!
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   c. "Notice in the top right corner the correct method for marking your answers on this answer sheet: fill in the entire circle corresponding to the answer you have chosen."
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   e. "In the second column under SEAT NO., blacken in the circle for the racial group to which you belong. Your choices are:

      (1) Black — (4) Spanish-American
      (2) White — (5) American Indian
      (3) Oriental — (6) Other

   f. "Under the section called GROUP NO., blacken in circle ②."
   g. "It is not necessary to put your name on the answer sheet, but you may if you wish."
5. Distribute the survey booklets. On the front of each is a black letter A, B, or C. Have the students blacken in the circle under TEST FORM according to the survey they have.

   THIS STEP IS ESSENTIAL!

   Do not continue until all students have completed this step. Each form of the knowledge test has different answers, so responses cannot be scored without the form letter.
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7. Students may work straight through the survey to the end. Please allow the entire class period for completion. Collect all the answer sheets when students have finished, <u>making sure each sheet has a form letter marked on it</u>.
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Thank you for your assistance.

Mrs. Rosanne Fortner
307 War Memorial Gym
College of Education, VPI & SU
Blacksburg, VA 24061

GENERAL INFORMATION

1. Name of School: _____

2. Cooperating Teacher: _____

3. The enrollment of this school is (circle one letter)
   a. more than 1500
   b. 1000 to 1500
   c. 500 to 999
   d. less than 500

4. Most of the population served by this school lives in a
   a. large city
   b. suburban area
   c. medium-sized city
   d. town
   e. rural area

5. The population served by this school is mostly
   a. upper class
   b. upper middle class
   c. middle class
   d. lower middle class
   e. lower class

6. The class taking this test is a __?__ class.
   a. science
   b. social studies
   c. language arts
   d. mathematics
   e. other subject (Specify: _____)

7. Circle as many answers as needed: A course dealing specifically with marine-related topics (marine biology, oceanography, or the like) is offered
   a. in at least one of our feeder schools
   b. in this school, in or before the tenth grade
   c. in this school, in grade 11 or 12
   d. not at all in this school

APPENDIX G.

CORRESPONDENCE CITED AS REFERENCES

University of Hawaii at Manoa

Curriculum Research and Development Group
(Including University Laboratory School)
Castle Memorial Hall 132 • 1776 University Avenue • Honolulu, Hawaii 96822
Telephone: 948-7961 • 948-7885

December 16, 1977

Rosanne Fortner
307 War Memorial Gym
Division of Curriculum and Instruction
Virginia Polytechnic Institute and
State University
Blacksburg, Virginia 24061

Dear Rosanne:

You are to be commended for making a start in an area that to my knowledge really has not been done well. I'm afraid I do not have the type of information you seek. Several evaluation specialists have been working here for the past two years to design and test instruments to get at the type of data you seek for our intermediate FAST (Foundational Approaches in Science) program (grades 7-9) which is now used by 85% of our schools.

So, we have some useful instruments. We've worked hard looking at Mirrors for Behavior (Simon and Boyer) plus evaluation schemes by Scriven, Stake, Poppern, etc.If you're interested, can and will share.

The big problem as I see it, and the reason why we have not yet done these studies on marine science students, is the current state of the art in marine science is so diverse in the schools that such a study would probably not be meaningful at this time. We've studied the content of extant courses, instructional approaches used, references and resources used and the type of teacher-made curricula in use. We also have student population statistics. We found that about 50% of the classes are for advanced students, the other 50% for students who opt out of other sciences, often with weak science or math backgrounds. Except for the eleven teachers who are now assisting us to systematically test out our first draft materials, what's being taught varies so widely (despite the state curriculum guide) that clear causal relationships wouldn't be feasible. For example, we found that lots of biology is taught, and that some classes are mostly marine biology (but that shouldn't be surprising since about 85% of our teachers have biology backgrounds). Some classes include arts, crafts, and literature, others are heavily into geology, chemistry and physics.

AN EQUAL OPPORTUNITY EMPLOYER

We have every intention of beginning the types of studies you are interested in to determine the effectiveness of our new HMSS materials. We feel that such an evaluation would be more appropriate if we wait until our second draft materials (revised and improved based on feed-back from pilot teachers) are in next fall. We will also then be very much interested in parallel comparison data on the effects of the status-quo teacher-made curriculum. So, please keep me informed of your progress.

By the way, Bob Stegner had mentioned that one of his Deleware grad students was planning to do some type of assessment. You might check there for details.

I hope my comments help somewhat. Please don't hesitate to write back for further information,etc. In the meantime, my warmest wishes to you and Wes for the holidays.

Aloha,

Barbara

Barbara Klemm, Assoc. Director
Hawaii Marine Science Studies Project

Encl: HMSS

BK:av

COLLEGE OF EDUCATION

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

DIVISION OF CURRICULUM AND INSTRUCTION

January 19, 1978

Dr. Peter M. Sandman
School of Natural Resources
University of Michigan
Ann Arbor, Michigan

Dear Dr. Sandman:

After reading your chapter in Swan and Stapp's Environmental Education, I am convinced that if anyone can help me identify some elusive research, you are that person. I am currently writing a dissertation in which I hope to identify the experiences which have led tenth-grade students to their present level of knowledge and set of attitudes pertaining to the oceans.

It seems impossible that such an obvious question of "where did you learn what you know" could have been overlooked as a topic for research, but nowhere have I found reference to any such studies. I suspect that level of marine education is influenced strongly by the mass media (specifically television and movies), or proximity to the coast, or both. To test these ideas I am surveying Virginia's tenth grade population as to their oceanic knowledge, their attitudes related to the oceans and our use of the oceans, and their marine-related experiences. This is something of a pioneering effort in marine education, but surely the technique isn't a pioneer in itself. The students simply check off the experiences they have had and rank those experiences in order of importance in teaching them about the ocean.

Do you know of any study which has employed a similar method? It doesn't need to be related specifically to environmental topics or to the media. I would appreciate any leads you may offer. Thank you for your assistance.

Sincerely,

Rosanne Fortner

(Mrs.) Rosanne Fortner

RF/tls

Dear Mrs. Fortner--

Your letter took a while to reach me at my current job at Cook College, Rutgers University. Sorry for the delay.

I think your methodology is, in fact, fairly common, though I can't offhand suggest any citations that might provide models. As I'm sure you know, the problem with asking people where they learned things is that they don't really know. One of the truisms of media research, for example, is that people will overestimate the influence of television; because TV

over

is so dominant in their lives, they tend to assume that they learned from television in ormation that in fact they got elsewhere. Another familiar problem is that both information and interest are probably cumulative and interactive; that is, the effect of a particular source may be dependent on other sources that are less visible/memorable. In your work, I'd imagine that living by the sea would significantly influence the influence of other sources of marine information and values--an interaction that your respondents would be unable to articulate. In my own work, environmental activists often report as influential a media source that turns out to be little more than a legitimation of less credible sources from the past; by telling people what they already feel, the media can make them feel okay about feeling it.

None of this, I imagine, is as helpful to you as a methodological bibliography would be--but I haven't got one for you.

Substantively, you might want to touch base with a former grad student of mine who is now working on marine education (at least Great Lakes education) in Michigan. You might have interests in common. If you're interested, write Ms. Leslie Lin, Michigan Sea Grant, University of Michigan, Ann Arbor, MI 48109.

Hope this helps a little. Good luck--and sorry for the delay and the informality of this note.

— Pete Sandman

VITA

Rosanne White Fortner was born in Logan, West Virginia, on November 13, 1945. She was educated in Logan County Schools and graduated from Logan High School in 1963. In 1967 she received the Bachelor of Arts degree in biology from West Virginia University, Morgantown, West Virginia.

After two years as an earth science teacher and science department chairman at Cave Spring Intermediate School in Roanoke County, Virginia, the author began part-time graduate work at Oregon State University, Corvallis, Oregon. She was employed as a research assistant in radiation biology at that institution until returning to Roanoke County in 1971. From 1972 until 1976 she was science department chairman at Hidden Valley Intermediate School, returning to Oregon State briefly to complete a Master of Science degree in earth sciences in 1973.

While a graduate student at Virginia Polytechnic Institute and State University, Blacksburg, Virginia, from 1976 to 1978, the author served as a teaching assistant and supervisor of student teachers. She also acted as an environmental education consultant to the Gifted and Talented Program in Montgomery County Schools, Virginia. Mrs. Fortner is the mother of two sons, Christopher Neil, 6, and Craig Michael, 19 months.

Rosanne W. Fortner

Rosanne W. Fortner

EXPERIENCES RELATED TO OCEANIC KNOWLEDGE AND ATTITUDES OF TENTH GRADE STUDENTS IN VIRGINIA

by

Rosanne White Fortner

(ABSTRACT)

The Survey of Oceanic Attitudes and Knowledge (SOAK) was developed as a method of measuring marine knowledge and attitudes of tenth grade students and relating those attributes to the students' marine experiences. Fifteen coastal and fifteen inland schools in Virginia were randomly selected as sources of subjects for the study. A cooperating teacher in each school administered the survey to a heterogeneous class of tenth graders.

Analyses of data from 787 respondents revealed a statewide knowledge level of about fifty per cent with regard to the marine topics covered by 63 items across three forms of the knowledge survey. Attitudes toward a variety of marine issues were shown to be moderately positive ($\bar{X}$ = 3.06 out of a possible 4.00). In order to examine the relationship between certain demographic variables and the dependent variables of marine attitudes and knowledge, a race by sex by residence analysis of variance was performed on the knowledge and attitude scores. For knowledge, the results indicated the main effects of race, and residence, and interaction between residence and sex. Substantively, the racial effects were such that white students scored higher than non-whites. The main effects of sex and residence on knowledge scores are qualified by an interaction such that knowledge differences by

residence exist only among males, with coastal males having a higher knowledge level. Only for coastal students are there pronounced differences between the knowledge scores of males and females, with males having the higher knowledge level. The analysis of variance for attitude scores according to the same demographic variables revealed main effects of race only, with white students expressing more positive attitudes. The relationship between marine knowledge and attitudes as measured by the SOAK was found to be .43, significant at the .01 level.

As part of the survey, students ranked marine experience categories according to their relative importance in providing information about the ocean. Both coastal and inland students identified television specials and movies with marine themes as being most influential in developing their marine awareness. Three specific experiences - watching Cousteau specials on television, reading National Geographic magazine, and being able to swim - were each shown to account for at least ten per cent of the variation in knowledge scores. Participation in ocean study courses was not shown to be related to higher knowledge or attitude scores. Descriptive data for the knowledge survey indicated that student performance was relatively consistent across items considering the ocean as a chemical medium, a biological community, a physical system, a threatened resource, a cultural influence, and a political interface. Greatest proficiency was evident in scores on items related to ocean chemistry ($\bar{X}$ = 53.8 per cent), while lowest scores were on items considering the impact of the ocean on human culture ($\bar{X}$ = 43.5 per cent). As for attitude trends, visual inspection of response means for attitude items revealed that respondents felt

most strongly about potential hazards to the marine environment. Political, economic, and personal considerations were also viewed positively, but attitudes were not as strong on these issues.

On the basis of the data, recommendations can be made concerning methods of equalizing access to marine-related experiences across demographic differences and utilization of specific item information to establish a baseline for further marine education. Because of the scope of modern marine education, the indicated level of overall marine awareness, and the apparent lack of significant effects of ocean study courses, it is recommended that more marine information be infused into existing curricula to foster the development of a marine-literate citizenry.